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Orthopaedic Practices In Post Covid Era

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Today, life of every person in this world can be divided into, BC and AC i.e. before corona and after corona. This is the amount of impact the novel corona virus has made, not only in India, but globally. Reasons are many. The novel corona virus is highly contagious, virulent and lethal especially in high risk groups. Since there is no treatment or vaccine available till date, prevention of spread of infection remains the main stay of treatment. This can be accomplished by stopping the spread of infection from the source via droplets or aerosols, which can be done by covering mouth and nose, social distancing, frequent hand washing and regularly disinfecting surfaces.

We the Orthopaedic surgeons working as health workers, due to nature of our work are more susceptible and vulnerable. Furthermore, Orthopaedic surgeries are aerosol generating procedures, which make them further more susceptible to infection. Our practise is further complicated by illiterate and reckless patients, untrained and irresponsible staff, deficient, shortage and unavailability of quality control equipment's, increased financial burden and daily changing irrational government policies. We have already seen our colleagues getting infected and even some have lost their life. Hence, for protecting ourselves, family members and our patients, we need to evolve, develop strategies and modifications, in our life as well as in orthopaedic practises so as to prepare and prevent rather than repair and rent the mis-happening. Further, we do not know as yet what complications and physiological responses will be encountered in post COVID-19 scenario. Hence with minimal current literature available, a balanced, pragmatic approach should be undertaken.

Various papers and articles have suggested guidelines, modifications and standard operative procedures to deal with pandemic situation. Planning is the key factor, in addition to the guidelines and standard operative procedures (SOP) as given by health care organisations. We as Orthopaedicians, also need to plan and modify our practices at each level relating to OPD, admission and surgeries, following all the standard precautions at all the times.

Patients visit in OPD or hospitals, should be minimized by favouring telemedicine or emails if possible, and favouring consultation by prior appointment only. Try to make definitive diagnosis and final treatment decision at first consultation only. Patient prioritisation in favour of non-operative strategies be emphasized. Referrals and transfers for investigation and radiology especially multiple times should be minimized and must outweigh the potential benefit of intervention, particularly for patients in vulnerable groups. Alternative resources such as written and web-based information should be used maximally.

Guard outside the clinic or hospital, can be trained to screen and isolate the suspected patients by taking fever history or by use of thermal screening. In OPD, clinicians should preferably use eye protection shield (face-mask or goggles) and N95 mask which can be re-used again after 5 days of incubation, whereas use of triple layer mask is sufficient for orthopaedic patients attending OPD. Mask dispensers can be installed in OPD and hospitals, so that the no touch mask can be prescribed to the patients coming without mask. The waiting room should be modified to have adequate room ventilation, so that there is at least 1meter distance between the patients allowing limited and restricted patient movement. The risk of infection, in healthcare workers can minimized by use of Personal protective equipment (PPE), which should be used correctly and safely even while donning and doffing. If possible, staff and helpers should work in rota's so that all are not exposed and you can have a reserve team if needed. In hospitals, surgical workforces are likely to be further depleted, as they might be

working in rota in half strength and rest might be reserved, quarantined or isolated, hence in these times, sub-specialty services may be difficult to run. These healthcare workers should be educated, aware and trained so that they change their behaviour in favour of maintaining social distancing, following standard precautions, frequent hand hygiene, refraining touching their eyes, nose, and mouth with potentially contaminated gloved or un-gloved hands, cleaning and disinfection of equipment and environment. If possible, use disposable equipment, if not possible then frequent cleaning and disinfection between each patient, be done. Avoid touching or frequently sanitize contaminated environmental surfaces e.g. door handles and light switches. Television, warnings, banners, disclosures and posters should be installed in OPD's with instruction to cover nose and mouth, maintaining social distancing and information and other preventive measures which can create awareness among people. Best practices for safely managing health care waste should be followed. Thorough cleaning and disinfection prior, between and after the use of OPD's as well as the operating theatre facilities should be re-enforced.

Dislocations, minor injuries, stab and penetrating non-contaminated wound without neurovascular deficit and minor to moderate abscess can be treated in the emergency department itself without admission. Most paediatric injuries, upper limb fractures and stable lower limb fractures have high rates of union and can be managed non-operatively, recognising that some patients may require late reconstruction. Delayed primary fixation of up to three months following injury may be acceptable if predictable favourable outcomes in delayed surgeries are weighed against the risks of surgeries. Patients with poly-trauma, pelvic, acetabular and hip fractures with major haemorrhage, open fractures, compartment syndrome and exsanguinating injury all require emergent resuscitation and management. Only absolute indication should be taken for surgery, like limb or lifesaving surgery, septic arthritis, prosthetic joint infection, amputations and re-implantation, crush injuries, cauda-equina syndrome, abscess and infections. Joint replacement and ligament reconstruction can be done at a later stage. Plan and facilitate the surgery such that multiple visits of patient to the OT and admission can be avoided. Re-surgery like, flaps, bone grafting, soft tissue reconstruction, skin grafting and amputations can be avoided by proper planning. Non-union, malunion or elective orthopaedic and spinal surgery should be deferred. Emphasize on reducing hospital admission and minimising length of stay by encouraging early discharge or day care surgery, if possible.

If surgery is planned, then patients as well as the staff both need to be tested prior, for COVID-19. Isolation prior to surgery will help to reduce transmission further. Surgeries should be planned only when appropriate supportive equipment e.g. ventilators, PPE and intensive care unit beds for post-operative care following surgery are available. Since Orthopaedic surgeries are aerosol-generating procedures use PPE, including gloves, long-sleeved gowns, balaclava, eye protection or face shield and powered air purifier respiratory (PARP) are recommended for all healthcare workers in OT. If PARP is not available then, N95 with goggles and balaclava with additional face shield covering skin to maximum can reduce infection risk. Use of laminar flow, positive pressure, space suits, pulse lavage or powered tools, drills, saw, reamers, suction irrigation reaming and other aerosol generating equipment's etc is not recommended. Shifting to un-reamed intramedullary nails, hand reamers and hand drills can be helpful. Surgery should be preferentially being done in adequately ventilated room, with negative pressure rooms with minimum of 12 air changes per hour or at least 160 litres/second in facilities with natural ventilation. Surgical theatre capacity is likely to be working with decreased strength, as they are likely to be redeployed to support non-surgical specialties, still then, unnecessary individuals in the room should be avoided. Use of suction with electro-cautery for smoke evacuation is recommended. Use of absorbable sutures, clear visible dressing and removable slabs or splits can reduce patient revisit for suture removal, dressings or cast

removal to hospital or clinic and prevent exposure. After surgery, proper donning off of the PPE kit is equally important as proper donning of kit to prevent infection, which needs to be practiced. Post-operative follow-up, dressing, antibiotics should be managed on telemedicine or remote consultations (e.g. telephone or video consultation), so as to avoid their hospital re-visit and face-to-face interaction. Appropriate arrangements to evaluate common post-operative complications at one stop visits be done. Enhanced recovery programmes, targeted video or home based rehabilitation will help in safe and early rehabilitation.

Ours is a developing country with limitations and hence we need to use resources judiciously. Proper allocation and optimisation of resources is necessary. One advantage in this time is Ayushman Bharat Yojna, which is world's largest health insurance scheme fully financed by the government of India, covering 107.4 million poor and vulnerable entitled families for health care hospitalization across public and private empanelled hospitals and involving more than 101 orthopaedic procedures and 12 polytrauma procedures enrolled in this scheme. Testing and treatment of COVID-19 is available for free under this Ayushman Bharat Yojna (scheme).

Rest, recuperation and psychological support is equally needed in addition, not only to the surgeon but all the team members. Hence, we Orthopaedic surgeons need to be flexible, dynamic, reactive and collaborative and show leadership in these testing times. Safety of the patients and the staff is foremost important hence conservative or minimal invasion methods with shorter hospital stay and short surgical times should be preferred. We should balance optimum treatment of a patient's condition against clinical safety and resources. The guidelines are not absolute and are continually evolving and updated; hence we need to be frequently in touch with new updated recommendations via web education and news along with feedback from our patients, till we can resume normalcy approved by the appropriate state health authorities. Possibly a second wave can occur so we must prepare ourselves by strictly following the policies of disinfection of surfaces, regular hand hygiene and social distancing in anticipation. We must seek this time as an experience and opportunity to focus on improving ourselves.

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Approach To A Clubfoot Deformity Patient: Ponseti Management

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Abstract

Clubfoot is among the most common congenital foot deformities, needing correction, which when left untreated can cause severe cosmetic, functional and social issues. Ponseti method has revolutionized the treatment in favour of nonsurgical serial manipulation and casting. Simultaneous correction of cavus, adductus, and varus followed by correction of equinus by percutaneous tenotomy can be achieved in mean 5 weeks. It is based on sound understanding of the functional anatomy of foot (synchronous movements of the tarsal bones at subtalar joint to unlock the deformity) and biological response of young connective tissue and bone to change in direction of mechanical stimuli which can gradually reduce or almost eliminate deformities of clubfeet. This review article describes, approach to a clubfoot patient, its features, classification, assessment, ponseti method of manipulation and casting and errors of treatment and their management. Aim of this review article is to compile the important information pertaining to clubfoot management which will be useful for the basic orthopaedic surgeon in their clinical practice and for post-graduate students.

Keywords: Club foot, Ponseti method, Manipulation and Casting

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Introduction

Clubfoot is the most common deformity of the bones and joints in new-borns. It occurs in about 1 in 1,000 live births. The chances of having a second child with a clubfoot are approximately 1 in 30. The cause of clubfoot is not exactly known, but it is most likely a genetic disorder with combination of unidentified environmental factors. Boys are affected three times more than girls. Clubfoot is bilateral in about half of the cases [1, 2].

Approach towards a clubfoot patient:

Assessment (diagnosis, classification and grading) At the first consultation in the clubfoot clinic, perform a complete history, visual foot inspection, general and musculoskeletal physical examination. Examine the cardiovascular, respiratory, gastro-intestinal, genito-urinary, and central nervous systems as well as the spine, upper extremities, hips, and feet to rule out other associated congenital abnormalities such as spina bifida (an open spinal cord), or arthrogryposis (multiple joint contractures) which suggest a syndrome. Then make a diagnosis of clubfoot, classify its type, and assess the severity of deformity by pirani score. This information helps to guide treatment and reassure parents about the treatment plans [1,4,18].

Diagnosis of clubfoot Congenital club foot has four components (CAVE) [1, 4, 18] (fig. 1):

a. Cavus – increased medial longitudinal arch.
b. Adductus - distal foot is deviated medially due to medial displacement of tarsal bones particularly navicular articulating only with medial part of the talar head, leaving lateral part of the talar head uncovered.

c. Varus -hindfoot is deviated towards the midline, as appreciated by looking from back due to adduction and inversion of calcaneum under the talus.
d. Equinus - severely plantarflexed foot.

Fig 1. Clinical photograph of CTEV child showing cavus (a), adductus (b), inversion (c) & equinus (d) (Drawn from Pirani S. Naddumba E. In: Staheli's Ponseti club foot management. Teaching manual for healthcare providers. 2008;1:1-48)

Classification for clubfoot [1,4,18]

a. Positional–due to intrauterine crowding foot is pushed or squeezed to one side and at birth looks like clubfoot, but is more flexible. They get better quickly after birth and do-not require treatment and prognosis is excellent.
b. Congenital idiopathic (typical) – most common type, only feet are affected and no other major abnormalities are present. It generally corrects in five casts and long-term outcomes are usually good or excellent.
c. Syndromic - clubfoot is part of a syndrome and other body parts are involved or other congenital abnormalities are also present. Ponseti's method is still the standard care but is more difficult, longer and unpredictable. Management of other deformities may complicate and determine the clubfoot management.

Grading by PiraniClubfoot Score[20]
It measures the deformity in clubfoot by changes in severity of six clinical signs, each scored as 0 (normal), 0.5 (mildly abnormal) or 1 (severely abnormal). It should be done for each clubfoot at every visit and recorded. It helps to assess the deformity objectively; correction achieved and indicates the time for need of Achilles tenotomy to correct the hindfoot pathology.

(A) **Mid foot score (MS)** – It measures the midfoot deformity and is sum of medial crease, curved lateral border and lateral head of talus. Values can range from 0 (no deformity) to 3 (severe deformity).

(i) **Medial Crease (MC)** - Normal arch displaying multiple fine skin lines is score 0. Mild medial contracture with one or two deeper creases that do not alter the arch's contour is score 0.5. A single deep crease indenting the arch's contour suggests severe medial/plantar contracture scores 1.

(ii) **Curved lateral border (CLB)** Normal foot with straight lateral border is score 0. Mild lateral curve with border at metatarsal is score 0.5. Lateral border that curves at calcaneo-cuboid joint scores 1.

(iii) **Lateral Head of Talus (LHT)** Uncovered talar head is estimated by abducting the deformed foot & palpating the talar head with thumb. Normally, abduction reduces the navicular completely to talar head which is no longer palpable and scores 0. With medial contracture, navicular does not fully cover over the talar head & is partially covers but remains somewhat palpable& scores 0.5. A talar head that does not cover at all & remains easily palpable scores 1.

(B) **Hind foot Score (HS)** – It measures hindfoot deformity and is sum of posterior crease, rigidity of equinus and emptiness of heel. Values can range from 0 (no deformity) to 3 (severe deformity).

(i) **Posterior Crease (PC)** Normal posterior ankle skin shows multiple fine creases and scores 0. Posterior heel with one or two deeper creases scores 0.5. Single deep crease changing the contour of heel scores 1.

(ii) **Rigid Equinus (RE)** Normal ankle extends at least 15^0 beyond neutral &scores 0. Ankle extension only to neutral scores 0.5. Extension short of neutral scores 1.

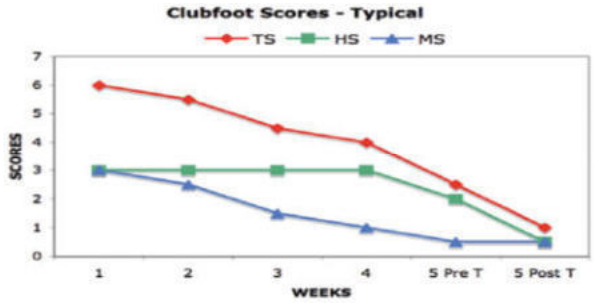
(iii) **Empty Heel (EH)** Normally calcaneus is palpable in extended ankle at heel and scores 0. A calcaneus that is palpable only

deeply scores 0.5 and a calcaneus that is not palpable scores 1.

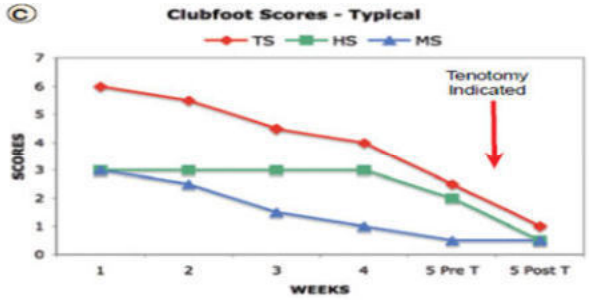
(C) **Total Score (TS)** - This is the sum of the HS and MS and indicates the amount of deformity overall. Values can range from 0 (no deformity) to 6 (severe deformity).

Pirani Score Assessment [4,20]

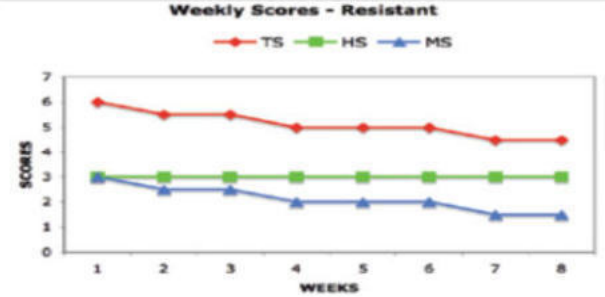
a. **Typical clubfoot**– initially has HS of 3 and MS of 3 (TS of 6), which at 2 to 4 weeks shows decreased MS but same HS i.e. at this time midfoot pathology is corrected(MS< 1) but hindfoot pathology persists (HS> 1). At this stage, Achilles tendon tenotomy is performed to correct hindfoot pathology and after tenotomy HS improved to 0.5, MS remained 0.5, & TS improved to 1(fig 2).



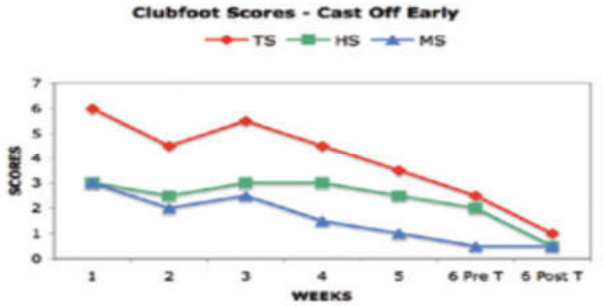
b. **Indication of Achilliestenotomy** - MS is 1 or less and HS is greater than 1(fig 3).



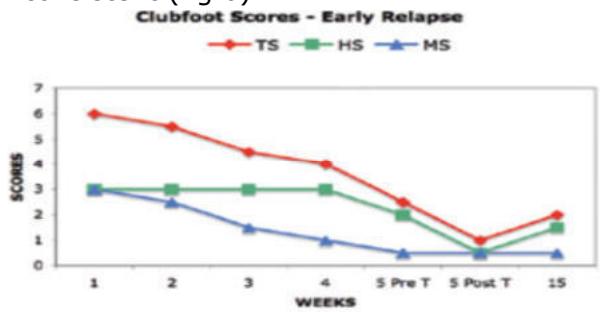
c. **Resistant clubfoot** - All scores drop or normalizes very slowly (fig 4).



d. **Cast removal early** - Scores rebound up during cast treatment if casts are removed before the clinic visit (fig 5).



e. **Early relapse**-Scores rebound up during brace treatment if bracing is inconsistent (fig 6).



History of Clubfoot Management

Treatment has been variable and controversial depending on the era [2,4].

a. Early treatment – First treatment was given by Hippocrates, who recognized the importance of starting the treatment early, before the bony deformity occurs [1,4]. William Cheselden at St. Thomas's Hospital, London was first to apply cast made of egg-white-soaked bandages. In 1820's Delpech, Stomeyer and Little were first to do Achilles tenotomy. Plaster of Paris casts were first used by M. Guerin in 1833. William Adams was pioneer to describe clubfoot pathology after dissecting stillborns [1,4]. In 1930, Kite advocated good correction by sequentially correcting the clubfoot deformity, but it took prolonged correction time (average 22 months) as it failed to take advantage of synchronous movements of tarsal bones at subtalar joint [5].

b. **Surgical methods –** Advent of antisepsis, anaesthesia and surgical tourniquet permitted surgical correction of deformity. In 1890, Extensive postero-medial releases were developed by Phelps, Duval, Ogston, and others. But in 1950, Steindler showed poor results (painful & stiff foot) in more

than 50% of surgical cases, leading to a reappraisal of nonsurgical methods [4,6,7].

c. **Ponseti method -** With advent of Ponseti method in 1990s, without doubt, the primary treatment of CTEV has remarkably shifted to Ponseti method all over the world [8-11].

Rational of Ponseti method

Ponseti's treatment is based on sound understanding of the functional anatomy of foot and biological response of young connective tissue and bone to change in direction of mechanical stimuli which can simultaneously correct cavus, adductus, and varus followed by correction of equinus, in mean duration of 5 weeks. He took advantage of synchronous movements of the tarsal bones at subtalar joint to unlock the deformity [4,12,13].

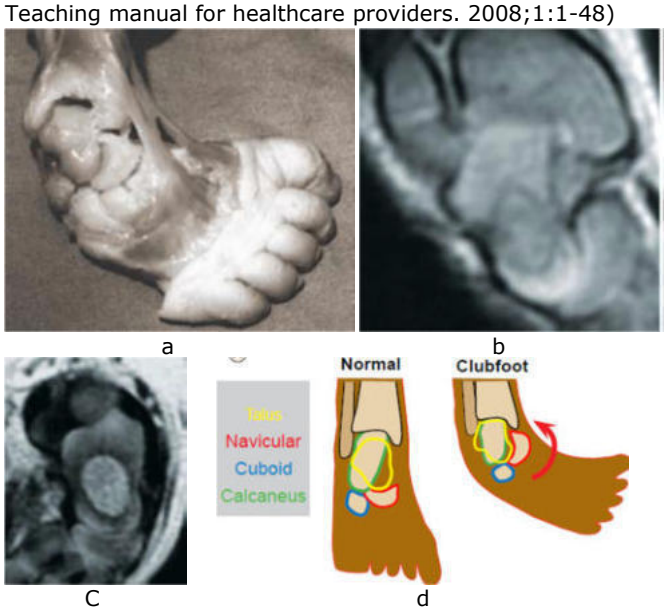
Patho-anatomy, biology and kinematic coupling by Ponseti

In 1966, with dissection of stillborn club feet, Ponseti revealed abnormalities in tarsal bones, tendons and ligaments, posteriorly and medially and abnormal intertarsal relationships, particularly navicular (fig 7). Muscles of the foot and leg were smaller, thick and taut than normal. According to him CTEV foot, fails to pronate, because the calcaneum cannot abduct, evert and dorsiflex, as it is locked under the talus in adducted, flexed and supinated position [13,14].

The bones of the new-born's foot are cartilaginous, which are less rigid and more easily moulded by external forces. Ponseti showed on MRI that this cartilage and young growing connective tissue (tendons and ligaments) responds biologically to low load tensions exerted by his manipulation and casting technique that stretches the contractures and remodels the abnormal tarsal cartilage [4,14-18].

He also analysed tarsal bone movements in normal and clubfeet and explained the kinematic coupling of tarsal bone movement by cine-radiographic studies that **Calcaneal adduction** is accompanied by inversion and flexion of the calcaneus and **Calcaneal abduction** is accompanied by eversion and extension. He used this for CTEV correction stating that, simultaneous calcaneal inversion or varus will correct only if it is abducted. To do so, he advised to abduct the forefoot with counter pressure against the head of the talus. This causes the calcaneus to abduct. As calcaneus abducts, subtalar motion interdependencies ensure simultaneous eversion and dorsiflexion. The clinical deformities of midfoot adduction, heel varus and equinus arising from calcaneal plantarflexion are therefore corrected together. It is very important not to touch the heel or block the cuboid from abducting because this blocks normal subtalar motion. Calcaneal dorsiflexion occurs mainly during terminal abduction. Therefore, a clubfoot is not adequately corrected until full abduction i.e. more than 70^0abduction is obtained [4,14-18].

Fig 7. Dissection (a) MRI section (b and c) of stillborn & illustration (d) of clubfoot showing tarsal abnormalities & abnormal intertarsal relationships (Drawn from Pirani S. Naddumba E. In: Staheli's Ponseti club foot management. Teaching manual for healthcare providers. 2008;1:1-48)



Acceptance of Ponseti Method

Ponseti performed clinical trials of his technique of manipulation and casting on several occasions (1963, 1972, 1980, 1992), but since the pathology and biology was poorly understood by clinicians, they did not adopt his method. Further his reports were not given due credit because they were not read accurately. It was only in 21st century that his technique was widely accepted, because of

very satisfactory long-term outcomes by independent observers, documented clinical proven effectiveness, MRI proven studies, parent demand of non-surgical treatment and re-emphasis on technical aspects along with clarification of common errors. It is universally accepted now that best treatment for clubfeet regardless of cost is Ponseti Method [8-11].

Ponseti manipulation and casting [1,4,18,21,22]

The foot is most receptive at or within a few weeks after the birth for Ponseti treatment by straightening the clubfoot by gently pushing the foot towards the correct position and retaining the corrected position applying a holding cast. Hence treatment should be started earliest. Cast (average 5 to 7 casts) are changed weekly or biweekly with additional corrections added at each visit. Correction is completed by a small cut just above the heel before the final cast, followed by bracing until 4 years of age to prevent relapse.

a. **Attitude** – Be kind, sensitive and reassure the parents making them understand overview of management and the importance of each step.
b. **Position** - Casting requires two skilled persons – a manipulator and an assistant along with the mother to hold the infant in her lap. All should be seated, with manipulator sitting laterally and assistant medially, with respect to affected foot, both facing the foot.
c. **Manipulation and casting** - The manipulator manipulates the foot to correct the deformity as much as possible without hurting the infant to stretch medial and plantar soft tissues. To do this, the manipulator's left hand moves up the leg and correction is maintained by gentle left thumb pressure over the upper leg. The manipulator's right hand continues holding the forefoot in the corrected position by applying some pressure to the talar head laterally and the assistant applies the padding and the cast over the foot and leg beginning from toes to knee (fig 8). If the child is at discomfort, then slow down, reduce pressure and allow child to calm.

Correction of deformities [1,4,18,21,22] (fig 8)

Correct cavus (first cast) - Cavus is due to pronation of the forefoot in relation to the hindfoot, which is supple in new-borns. Elevating the first metatarsal for about 30 seconds to stretch the plantar tissues and supinating the forefoot by the manipulators right hand will correct the cavus restoring normal longitudinal arch aligning it with the hindfoot, this is followed by abducting the foot. Cast 1 corrects cavus and can correct some adduction, which is necessary before correcting the adductus and varus.

Fig. 8. Ponseti's manipulation showing cavus correction by supination (a) & correction of adduction &inversion by abduction and counterpress at talar head for 2nd to 4th cast (b) and application of cast (c), moulding (d) and final photo after cast (e). (Drawn from Pirani S. Naddumba E. In: Staheli's Ponseti club foot management. Teaching manual for healthcare providers. 2008;1:1-48)

Correct adduction & heel varus (2nd to 4thcast) - Forefoot adduction is due to medial displacement of navicular on talar head and cuboid on calcaneus. Heel varus is due to adducted and inverted calcaneus under the talus. Both deformities are corrected by manipulating and casting the supinated foot gradually into full abduction, by holding the entire foot in gradually increasing abduction and pressing the lateral talar head with thumb with casts 2, 3 and 4. For identification of talar head, palpate the lateral malleolus with thumb and then slide the thumb forward 1 to 1.5 cm to palpate the head of the talus. Heel varus and adduction will correct simultaneously when the entire foot is fully abducted.

Correct equines (5th cast) after achieving 70^0 abduction start correcting equinus by dorsiflexion of foot or it may need percutaneous tenotomy of the tendoachillies. Full abduction correction can usually be achieved with cast 5.

d. **Moulding** – The manipulator stabilizes the knee and holds foot in corrected position while the assistant moulds the cast by his left hand at the arches and bony prominences and right hand give counterpressure. The assistant's hands and fingers move continuously to reduce the risk of pressure sores while the plaster sets. Moulding causes the cast to fit snugly, gives appearance of the foot and prevents slippage, pressure sore or secondary deformity.
e. **Above knee extension** –Once lower section is set, the cast is extended above the flexed knee (90 degrees) to avoid the possibility of the cast slipping off the leg.
f. **Trimming** – The child is cleaned and cast is trimmed to remove excess plaster to leave the toes uncrowded but supported [H].
g. **Instruction**–Parents are reassured, encouraged and asked to regularly observe toes for change colour/swell, swelling, baby cries, or not feeding or the cast gets wet. In case, this happens instruct them to revisit or soak the cast and remove it immediately.
h. **Cast removal -** Casts should be removed in clinics just before a new cast is applied else correction can be lost from the time the cast is removed until the new one is placed. Initially soak the cast in water for about 20 min, then softened cast can be removed by unrolling the plaster (easiest if end knob is found), by plaster shear blade, plaster knife or scalpel cutting obliquely. Electric cast saw are not recommended. Start cutting from anterior or lateral side of groin moving downward cutting only cast not the padding, removing first above knee part followed by below knee part (fig 9).
i. **Cast appearance –** With each cast foot shows improvement and progressively abducts 20^0 each time. After 4th cast, full cavus, adductus, and varus correction is seen. Equinus also gradually improves because the calcaneus dorsiflexes as it abducts under the talus sono direct equinus correction is required, but it may require a percutaneous tenotomy of the achilles tendon. Attempted dorsiflexion against tight tendo-achilles causes a rocker bottom foot deformity.
j. **Complications of casting** – superficial and deep pressure sores can occur specially at talar head or heel. **Superficial sores** are managed by applying a dressing and a new cast with additional padding. **Deep sores** are dressed and left out of the cast for one week to allow healing and after healing Casting is resumed.

Fig 9. Clinical photos showing cast removal by plaster cutter (a), knife and blade (b), initialy removing above knee and then below knee (c &d). (Drawn from Pirani S. Naddumba E. In: Staheli's Ponseti club foot management. Teaching manual for healthcare providers. 2008;1:1-48)

Step 3 – Achilles tenotomy

Tenotomy is done to correct equinus when cavus, adductus, and varus are fully corrected but ankle dorsiflexion remains less than 10^0 above neutral. It is only a small cut just above the heel before the final cast not an extensive surgery, which can be done in the clinic under local anaesthetic (fig 10) [1,4,18,21,22].

a. **Indication -** There are two ways to tell if tenotomy is indicated. Firstly,clubfoot is sufficiently corrected to proceed with tenotomy when the anterior calcaneus is abducted away from under the anterior

talus and with sufficient abduction of 70^0, the talar head becomes unpalpable laterally. Secondly, tenotomy is indicated when the Midfoot Score is one or less and the Hind foot Score is more than one (the Lateral Head of Talus Sign should be zero).

Fig 10. Clinical photographs showing steps of tenotomy (a to d)(Drawn from Pirani S. Naddumba E. In: Staheli's Ponseti club foot management. Teaching manual for healthcare providers. 2008;1:1-48)

a b c d

b. **Position –** The baby is placed at the end of the examination table with surgeon at the feet, and the assistant to the ipsilateral side. With one hand, the assistant holds the limb firmly at the knee, holding the knee straight. The other hand dorsiflexes the foot to stretch the achilles tendon.

c. **Preparation and anaesthesia -** The surgeon preps the foot thoroughly from midcalf to midfoot with an antiseptic and then palpates the spot where the tendon feels most prominent, usually about one to one and a half centimetres above the calcaneus, and infiltrating a small amount of local anaesthetic just medial to this point. Be aware that too much local anaesthetic makes palpation of the tendon difficult and the procedure more complicated.

d. **Technique of Heel cord tenotomy** - Insert the tip of the scalpel blade from the medial side, directed immediately anterior to the tendon. Keep the flat part of the blade parallel to the tendon. The initial entry causes a small longitudinal incision. Care must be taken to be gentle so as not to accidentally make a large skin incision. The blade is then rotated, so that its sharp edge is directed posteriorly towards the tendon. The blade is then moved a little posteriorly and a "pop" is felt as the sharp edge releases the tendon. The tendon is not cut completely unless a "pop" is appreciated. An additional 15^0 to 20^0 of dorsiflexion is typically gained after the tenotomy. A small amount of bleeding is normal. A piece of clean gauze is placed over the incision and above-knee plaster cast applied.

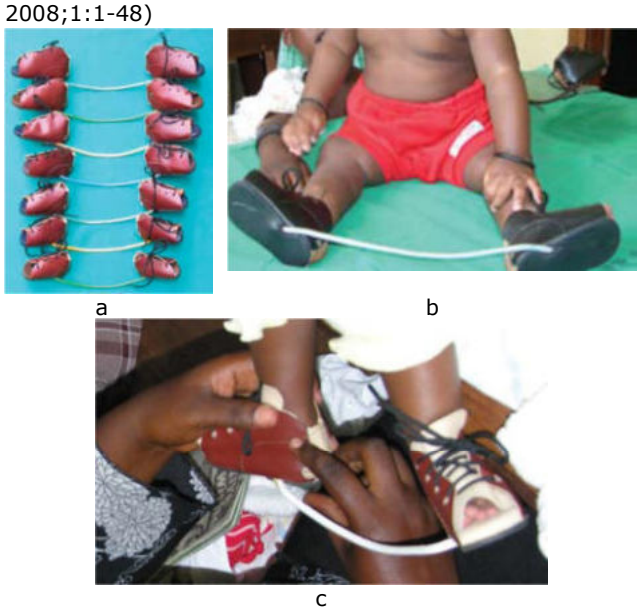
e. **Post tenotomy cast** - After correction of equinus by tenotomy, with the foot abducted 60^0 to 70^0& 15^0 dorsiflexion, last cast is applied for 3 weeks. The foot looks overcorrected with respect to the thigh. It should be replaced if it softens or becomes soiled before 3 weeks. Usually no analgesic is necessary.

f. **Cast removal** - After 3 weeks, the cast is removed and20^0 of dorsiflexion is now possible and foot is ready for bracing.

Step 4 – Bracing

Bracing is in-dispensable for preventing relapse of deformity by holding the foot in the corrected position. Follow-up at regular intervals for compliance of brace is essential and critical for successful management. Brace should hold the foot abducted and dorsiflexed – hence the term **foot abduction brace** (fig 11)[4,18,21,22].

Fig 11. Foot abduction brace of different sizes (a) and clinical photograph of child with brace (b and c) (Drawn from Pirani S. Naddumba E. In: Staheli's Ponseti club foot management. Teaching manual for healthcare providers. 2008;1:1-48)



a b c

a. **Type -** Can be commercially available foot abduction braces (such as the Markell or Mitchell Brace) or custom made.

Commercially available braces are expensive and availability is an issue.

b. **Feature –** It should be simple, easily available, effective in maintaining correction, easy to use, easy to fabricate, inexpensive, and ideally suited for widespread use.
c. **Shape –**Brace has two shoes and round connecting iron bar. Shoes are open toe, leathered, with lace closures and holes in heel to check position. Abduction and dorsiflexion can be changed by bending the bar.
d. **Position and length–**the brace should maintain foot abduction 70^0 and dorsiflexion 15^0. Length of foot abduction bar i.e. distance from the inside of one shoe-heel to the other shoe-heel equals the width of the child's shoulders.
e. **Design -**Heel has low posterior or deep cup design (at the level or below the level of the anatomical ankle joint) in plantar flexion to prevent foot from slipping out and to promote normal shaped foot development. In contrast, if the heel leather is increased and it reaches above the ankle joint, it acts as a fulcrum causing the heel to lift up from the shoe when the child attempts to plantarflex the ankle.
f. **Fitting** - properly fitted brace should not be painful. If the child cries, they should check for sore areas and needs brace adjustment to fit properly.
g. **Time and duration –**It should be used full time for 3 months and at night time until 4 years of age regularly and without skipping even one day.
h. **Availability –**Stock FABs in the clubfoot clinic so that they are available for immediate initial fitting and replacement, reducing relapse and transportation costs.
i. **Follow-ups**- should be done at regular intervals to minimize problems and to detect relapse early. First at 2 weeks and then every 3 monthly till 2 years' age and then 6 monthly till 4 years' age.
j. **Discontinue** –brace can be discontinued after age of 4 years if there is no sign of relapse. If there is any sign of relapse, reapply a series of corrective casts.
k. **Compliance** - Failure to comply with bracing protocols is the most common cause of relapse. To prevent relapse, educate, demonstrate, reassure and ensure consistency.

Outcome of Ponseti Method

Correctly applied cast is successful in almost all the cases, and it depends on experience of treating team, compliance of family and degree of stiffness of foot. Feet treated by this method are strong, flexible, and pain free, allowing a normal life, although affected feet and leg may be slightly shorter and narrower than the normal foot, but it makes no difference [8-11, 19].

Recommended visits

About total 20 visits over four years leads to optimal outcomes.

Corrective phase - requires 7 visits – 5 weekly visits for five casts, 6th visit after 3 weeks of tenotomy for fitting of FAB, and 7th visit 2 weeks later for brace-wearing compliance check.

Maintenance phase - every 3 monthly till walking age, and then every 6 months till 4 years' age for assessment of relapse and brace compliance.

Development & modification in Ponseti technique

The technique is equally effective in hands of paramedical hands and corrects deformity even in older child, complex, atypical and syndromic clubfeet. But it is complicated and may take longer duration (average 10 to 12 casts).Accelerated protocol with cast changes every 4 to 5 days can shorten duration time [23].

Errors or cause of failure in management [24]

a. **Failure to recognize clubfoot -** is a result of lack of awareness of clinical features of clubfoot or knowledge that it can be treated. Can be overcome by education, awareness and performing visual foot inspection.
b. **Manipulating without accurately identifying talar head -**This error is commonly due to inexperience. Successful correction of deformity depends on abduction of the calcaneus under the talus,

by counter-pressure on the head of the talus. Failure to counter-press talar head will impede the correction. This can be prevented by accurately identifying the head of the talus, by palpating the lateral malleolus and move forward to identify the next bony prominence – the head of the talus.

c. **Pronation of the foot -** This worsens the deformity by increasing the cavus. Pronated forefoot with adducted and inverted calcaneus cannot be abducted and remains locked under the talus. So foot should never be pronated.
d. **Failure to cast -** Performing frequent manipulations and not casting is an error. The foot should be casted with the contracted ligaments at the maximum stretch obtained after each manipulation. The stretched ligaments loosen sufficiently to facilitate further stretching at the next manipulation.
e. **Using below-knee casts -** Below-knee casts do not hold the calcaneus abducted. Above-knee casts are needed to prevent ankle and talus from rotating within the cast.
f. **Applying cast alone, without help –**It jeopardizes the correction by introducing the possibility of immobilizing the foot in an in correct position. It is preferable to have a parent/helper to hold the foot during cast manipulation.
g. **Premature equinus correction -** Attempts to correct the equinus before the heel varus and foot supination results in a rocker-bottom deformity. Equinus through the subtalar joint can be corrected only if the calcaneus abducts. Tenotomy is indicated after cavus, adductus and varus are fully corrected.
h. **Failure to perform a complete tenotomy-** Sudden lengthening with "pop or snap" signals a complete tenotomy, Failure to achieve this 'pop or snap' indicates an incomplete tenotomy, requiring to repeat the tenotomy manoeuvre.
i. **Errors during bracing** Bracing in done in fully corrected position with foot abduction and ankle extension. Bracing into pronation, eversion or external rotation, can cause relapses and treatment failure.
j. **Using braces other than FAB -Ankle foot orthosis (AFO)** controls ankle extension but cannot maintain the adduction of calcaneus under the talus. **Knee-ankle-foot-orthosis** controls for foot abduction, but is inefficient at controlling for ankle extension, as it keeps knee in a permanent 90^0 flexion so does not stretch the gastrocnemius muscle satisfactorily. Hence, when child starts standing with extended knees foot will have an equinus contracture.
k. **Failure to recognize relapse early –** Relapse can be identified early by observing the child's gait, which shows early heel rise (child walking away from examiner), swing phase dynamic supination (child walking towards examiner) and loss of ankle dorsiflexion to less than 10^0. These relapsed can be managed by repeat corrective casting.
l. **Management without bracing -** Avoiding the brace entirely is tempting and has shown 90% relapse rates at age of 1 year. Relapse is rare after 4 years, hence bracing until 4 years of age is necessary to reduce relapse.
m. **Attempts to obtain perfect anatomical correction -** It is impossible to achieve complete anatomic correction by Ponseti treatment. Long-term follow-up radiographs show some abnormalities, but it does not correlate with long term, good clinical and functional, supple and plantigrade foot, obtained by Ponseti method.
n. **Non-compliance**- irregular follow up in casting phase, not using brace until 4 years, will cause relapse.

Other Clubfeet Situation

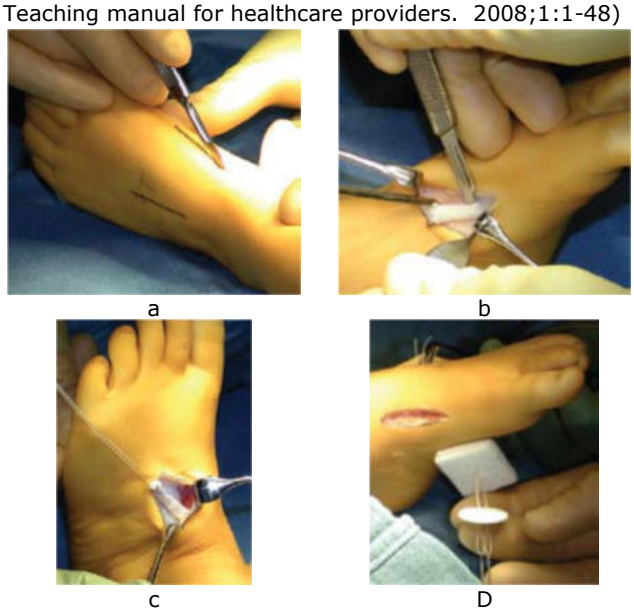
Most idiopathic congenital clubfeet correct with about five well-applied Ponseti casts. Some clubfeet, however, can be considered "difficult" as they have some unique characteristics that demand a modified approach for management [1,4,18,21,22,25].

Relapse [1,4,18,21,22,25]
Ponseti method corrects deformity, but it does not remove the cause and so it has tendency to recur.

a. **Cause** – It is almost always due to failure or incorrect bracing and may indicate neuromuscular disorder.
b. **Age of presentation** - relapse occurs before 5 years of age and is very rare after age 7.
c. Sequence - Early relapse presents as a loss of dorsiflexion, later, heel varus and adductus develop and rarely significant cavus may recur. Early relapse is therefore easier to correct than late relapse.
d. **History –** take history relating to bracing difficulties (pain, inconsolable crying, sore areas,) that led to inconsistent use or improper use like heel not touching down on the footplate of the shoe.
e. **Signs of relapse –** are different for before walking and after walking age.
   1. **Before Walking Age –** Suspect relapse if the brace has incorrect angle of abduction and dorsiflexion, if the talar head remains palpable with the foot in maximal abduction, if the calcaneus cannot be abducted and extended, if heel cannot go into valgus or if dynamic supination present (involuntary supination of foot with active ankle dorsiflexion representing tibialis anterior hyperactivity unopposed by weak peroneal).
   2. **After Walking Age -** Observe the child's feet in standing and while walking towards and away in swing and stance phases of gait. In early relapse, ankle dorsiflexion is less than 10^0 above neutral with knee extended, though foot appears plantigrade, the heel may not touch the ground and heel rise occurs on walking. In late relapse, the medial forefoot is raised off the ground, or the foot bears weight on the lateral border. When child is walking towards examiner foot tends to supinate in swing phase (dynamic supination) and bears weight lateral rays whereas when child walks away, heel-strike is absent, and there is fixed stance-phase heel varus. Subtalar joint involvement (as loss of full calcaneal abduction or incomplete talar head coverage) indicates late relapse. Active ankle dorsiflexion may be accompanied by supination of foot due to tibialis anterior over activity and Sole of foot may show thickening of the skin laterally.
f. Treatment or relapse - Do not ignore relapse, as early relapse is much easier and less complicated than late relapse. Relapse is treated with repeat manipulation and casting, adding tenotomy if needed, followed by bracing. After 30 months of age, relapse along with repeat manipulation, casting and tenotomy needs, transfer of the tibialis anterior to the lateral cuneiform to turn the deforming force of tibialis anterior into a corrective force.

Anterior Tibialis Tendon Transfer [1,4,18,21,22,25] (fig 12)

Fig 12. Clinical photograph of tibialis anterior transfer for dynamic supination showing incision (a), tibial anterior harvest (b), transfer of tendon to cuneiform (c) and securing tendon plantarwards (d). (Drawn from Pirani S. Naddumba E. In: Staheli's Ponseti club foot management. Teaching manual for healthcare providers. 2008;1:1-48)



a. Indication – It is indicated when child had second relapse with persistent heel varus and forefoot supination during walking and the sole shows thickening of the lateral plantar skin.
b. Age – child should be more than 30 months old.
c. Prior deformity correction - Fixed deformity should be corrected by casts before tendon transfer. Usually cavus, adductus, and varus corrects, but equinus may be resistant. If the foot easily dorsiflexes to 10^0, only the transfer is needed, else heel cord tenotomyis added.

d. **Anaesthesia, positioning and incisions -** Under general anaesthesia in supine position with high thigh tourniquet, dorsolateral incision centred on the lateral cuneiform is made. The dorsomedial incision is made over the insertion of the anterior tibialis tendon.
e. **Procedure -** Anterior tibialis tendon is detached at its insertion and anchoring sutures are placed by multiple passes through the tendon to obtain secure fixation. Transfer the tendon to the dorsolateral incision under the extensor retinaculum and extensor tendons. **Localize lateral cuneiform radiographically** and make a drill hole in the middle of the lateral cuneiform large enough to accommodate the tendon. Thread a straight needle on each of the securing sutures and pass both needles into the hole and penetrates the sole of the foot, with needles **Passing through** different holes of secure button placed plantarly, with foot held in dorsiflexion, pull the tendon into the drill hole by traction on the fixation sutures and tie the fixation suture with multiple knots.
f. **Supplemental fixation-** Supplement the button fixation by suturing the tendon to the periosteum at the site where the tendon enters the cuneiform, using a heavy absorbable suture.
g. **Local anaesthetic and closure -** Inject long-acting local anaesthetic into the wound to reduce immediate postoperative pain and close wound with absorbable subcutaneous sutures.
h. **Cast immobilization-** apply a long-leg cast with foot in abduction & dorsiflexion.
i. **Postoperative care -** Usually, the patient remains hospitalized overnight. Remove the cast and button at 6 weeks. The child may mobilize weight-bearing as tolerated.
j. **Bracing and follow-up -** No bracing is necessary after the procedure. See the child again in 6 months to assess the effect of the transfer.

Neglected / Untreated clubfoot in the older child [1,4,18,21,22,25]

Late presenters or neglected CTEV are common in our country due to social stigma, lack of education, poverty and lack of proper health services and are difficult to treat due to severe deformity, contractures, deformation of bones, callosities and ulcers.

Treatment–Ponseti method continues to be effective even after walking age but these cases need longer treatment, and may have residual deformity, necessitating further treatment like calcaneo-cuboid fusion for residual calcaneo-cuboid subluxation.

Complex congenital clubfoot (atypical clubfoot)(fig 13)

Fig 13. Clinical photo of complex club feet (a & b) showing are deep crease just above the heel and at sole, and short hyperextended big toe with an edematous dorsum of the foot and (c) modified treatment by extending all metatarsals to align forefoot with midfoot. (Drawn from Pirani S. Naddumba E. In: Staheli's Ponseti club foot management. Teaching manual for healthcare providers. 2008;1:1-48)

a b c

It is recently described variant of congenital clubfoot. It is important to recognize it, as treatment needs modification and there is an increased risk of relapse [1,4,18,21-25].

a. **History –** often history of casts slipping is present such that the toes slowly disappear inside the plaster
b. **Examination -** Signs of complex clubfoot are rigid equinus, plantaris (severe plantarflexion of all metatarsals), a deep crease just above the heel, a deep transverse crease across the sole of the midfoot, a short hyperextended big toe, abnormal "flattened" shape to heel and an oedematous dorsum of the foot.
c. **Why Modify treatment -** Use of classic Ponseti method, in this atypical clubfoot results in secondary deformity (Persisting cavus, increase in plantaris and abduction of metatarsals at the lisfranc joint rather than abduction of calcaneus) and hence modification is needed

d. **Modification –**For correction of plantaris, all metatarsals are extended simultaneously with both thumbs. Following this start abducting foot with counter press at lateral talar head. Apply casts with the above-knee portion in 110^0 flexion to prevent slippage. Average10 casts can be needed.
e. **Tenotomy** A tenotomy is necessary in all cases. Perform the tenotomy when plantaris corrected. At least 10^0 dorsiflexion is necessary. Sometimes it is necessary to change casts at weekly intervals after the tenotomy to gain more dorsiflexion, if sufficient dorsiflexion is not achieved immediately after the tenotomy.
f. **Bracing** Reduce abduction on the affected side to 40^0 in the foot abduction brace. The follow-up protocol remains the same.

Syndromicclubfoot

Congenital abnormalities, such as arthrogryposis, myelomeningocoele, and other syndromes, often have abnormal collagen forming their ligaments, capsules, and other soft tissues. Hence syndromic clubfeet are difficult to treat. Many syndromic clubfeet, correct and plantigrade foot can be achieved with standard Ponseti method however; correction may require more casts than usual. Long-term functional outcome usually depends more on the underlying syndrome than the clubfoot [1,4,25].

Resistant clubfoot

Rarely, idiopathic congenital clubfeet do not correct completely with accurately applied Ponseti treatment due to co-existing pathology such as tarsal coalition the surgical correction by posterior or posteromedial release is necessary [1,4,25].

Conclusion

Neglected club foot can affect adversely on functions and cosmetic appearance; hence treatment should start at earliest as possible. Ponseti method, based on sound understanding of functional anatomy and biological response of tissue ,showed excellent results with nonsurgical serial manipulation and casting, simultaneously correcting all the deformities. Cavus is corrected in first cast by supinating the foot followed by correction of varus and adduction, by abduction the foot, with counter pressing lateral talar head, followed by correction of equinus by percutaneous tenotomy in mean 5 weeks. Post treatment bracing is necessary to prevent the relapse till age of 4 years. The technique is equally effective in hands of paramedics, in older child, complex atypical and syndromic clubfeet, although it may take longer duration to correct. Feet treated by this method are strong, flexible, and pain free, although affected feet are slightly shorter and narrower. Pirani score can objectively document this correction and also identify early relapse.

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Outcome Of Postero-Medial Soft Tissue Release In Congenital Talipes Equino Varus

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Abstract

Background: Clubfoot is one of the most common congenital orthopaedic anomalies, first described by Hippocrates in the year 400 BC. However, its treatment still continues to challenge the skills of the paediatric orthopedic surgeon as it has a notorious tendency to relapse, irrespective of whether the foot is treated by conservative or operative means.

Material & Methods: This prospective study was conducted at our center from June 2014 to May 2016 in 39 (31 cases) congenital talipes equinovarus deformities treated by single stage posteromedial soft tissue release and the outcome assessment was done by Pirani score and Green, Lloyd- Roberts criteria.

Results: The mean age was 1.7 years. 21 were male and 10 were female. The mean pre-operative Pirani score improved from 4.8± 0.82 to 1.4± 0.86 postoperatively, which was statistically significant ($p < 0.05$). As per the Green Lloyd-Roberts criteria 13 (37%) feet had excellent results, 13 (37%) feet had good results and 9 (25%) feet had poor results. 6 feet had superficial infection or wound gaping and plaster sore and skin blisters were seen in 4 feet.

Conclusion: Single stage Postero-Medial Soft Tissue Release produces satisfactory results when done at appropriate age as soft tissues are more resilient to correction and the remodeling capacities of the cartilaginous bone are good.

Keywords: Clubfoot, CTEV, Posteromedial soft tissue release, PMSTR

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Introduction

Clubfoot (CTEV) is one of the most common congenital orthopedic anomalies, first described by Hippocrates in the year 400 BC [1,2]. The aim of treatment in CTEV is to achieve cosmetic, anatomical and functional foot which is acceptable to the child and to the parents [3,4]. Despite this long experience in treating clubfoot deformities, there still exist controversies regarding both the treatment methods i.e. conservative or surgical. Comparison between the groups is further complicated by lack of standards for evaluating the functional outcomes.

Conservative method, as developed by Ponseti, which begins immediately after birth and is based on the fundamentals of kinematic coupling and patho-anatomy of the deformity, and is quiet successful and well accepted initial step in realignment of clubfoot deformity in infants without the need of extensive and major surgeries [3-8]. But, still there are few deformities that do not respond at all to the conservative line of treatment even after serial

manipulation and casting (rigid clubfoot), or some deformities recur after initial correction by conservative management (relapsed clubfoot) orrecur after the completion of the treatment (recurrent clubfoot) [2,9]. All of these feet along with the feet which had never received any treatment (neglected clubfoot), require surgical correction. During the early years of infancy, the deformity can be surgically corrected by single stage posteromedial soft tissue release. Hence we evaluated the outcomes of single stage posteromedial soft tissue release in rigid, relapsed, resistant or neglected clubfoot deformity children in early infancy.

Material and Methods

This prospective study was conducted at our center between 2014 to 2016 in 31 CTEV children. Primary idiopathic rigid, relapsed, recurrent or neglected CTEV aged between 6 months to 5 years were included in the study. Initially in all these cases Ponseti's method [5,6] of cast correction was attempted, and when it failed due to late presentation of child, lack of compliance, walking of child on the cast, illiterate parents, irregular weekly follow-up and inconsistent use of brace after correction, these cases were included for the study. In some of the bilateral cases, one side foot deformity was corrected by serial casting and hence only the other side, which was not corrected or relapsed was only included. Secondary clubfoot, previously operated feet, atypical clubfoot, clubfoot with non-healing ulcers over callosities, and children more than 5-year age and less than 6 months were excluded from the study.

All the cases were operated via standard posteromedial soft tissue release procedure done under general anaesthesia in supine position under tourniquet control [2]. Postoperatively, all the cases were given an above knee cast with full correction of deformity. All cases were regularly followed biweekly and after 2 weeks the cast was removed and suture were cut and the cast was reapplied for further three weeks. After three weeks the cast was removed and patient was allowed to walk with normal shoes, whereas child was given foot abduction night brace for further 6months to prevent relapse. The outcome assessment of the deformity was done by Piraniscore and using Green, Lloyd-Roberts criteria [10,11].

Results

Total number of 39 feet (31 cases) of congenital talipes equinovarus deformity (CTEV) treated with single stage posteromedial soft tissue release were included in the study. Bilateral deformity was seen in 16 cases (24 feet) and unilateral deformity was seen in 15 cases (15 feet). The mean age of children in the study was 1.7 years. 21 were male and 10 were female. 4 cases were lost to follow-up and hence cohort comprised of 35 feet, which were included in the study.

In all the cases, full correction of the deformity was achieved. The overall mean pre-operative Pirani score improved from 4.8± 0.82 to 1.4± 0.86 at the end of 6 months postoperative follow up, which was statistically significant ($p < 0.05$).

11 (28.2%) feet were neglected cases in which no cast application was done, while 28 (71.8%) feet were either rigid, relapse or resistant cases i.e. in which previous cast application was attempted. The preoperative mean Pirani score for the feet who had no prior cast application was 5.09 ± 0.94 and for the patients who had prior cast application was 4.11 ± 0.92. The difference was found to be statistically significant ($P < 0.05$). The postoperative mean Pirani score for feet who had not received any prior cast application was 1.73 ± 0.91 and for the feet who had received prior cast application was 1.18 ± 0.91. The difference was not found to be statistically significant ($P > 0.05$), showing that there was no difference in the postoperative Pirani score between prior cast application and no prior cast application. As per the Green Lloyd-Roberts criteria 13 (37%) feet had excellent results, 13(37%) feet had good results and 9 (25%) feet had poor results.

6 feet had superficial infection or wound gaping at the incision site, all of which healed

with oral antibiotics and regular dressings. Plaster sore and skin blisters were seen in 4 feet, which were due to improper padding or due to tight cast or sweating inside the cast, all of which healed spontaneously with cast holiday, antiseptics and antibacterial/antifungal dusting powder and none of the sores deepened.

Discussion

Neglected, rigid, resistant or relapse CTEV cases, have always been a difficult challenge to treat, because of many reasons, like late presentation, walking child, already longer treatment duration, soft tissue contractures and remodelling and alteration of the deformed tarsal bones [9]. Hence, these clubfeet require surgical treatment, by soft tissue release in early years of infancy or bony procedure in an older child [2].

We evaluated the outcome of rigid, relapse, resistant or neglected 39 clubfeet deformities in children between 6 months to 5 years' age, treated by single stage posteromedial soft tissue release. Our study was comparative to other studies in terms of mean age, number of cases, laterality and male to female ratio [12-15].

These studies differ in assessment criteria and scoring systems making the comparison, difficult [12-15]. Hussain et al [16] used modified Mckay rating system; Ajmera[9] used Ferreira score whereas Menezes et al [12]in his study used Wayne-davis scoring system for assessment. We used both Pirani and Green, Lloyd-Roberts clinical criteria for assessment [10,11]. Since Pirani score is most commonly and widely used system [17], but its use in older child can be debatable and Green, Lloyd- Roberts clinical criteria based on appearance, function and pain during activity, is reliable in older child, hence we used both Pirani and Green, Lloyd- Roberts's criteria for assessment.

In our study, overall mean pre-operative Pirani score improved from 4.8to 1.4 at final follow up, which was statistically significant. Since these feet were rigid, relapsed, neglected or resistant in an older child, even the postoperative score remained a little bit higher as compared to other studies [9, 12-16]. In our series, the mean preoperative Pirani score in neglected cases (prior no cast application) was significantly higher than rigid, relapsed or resistant cases (previous casting done). This higher Pirani score in neglected cases was maintained in the postoperative period as well, although it was not significant. Hence we concluded that preoperative cast application positively affects the final outcomes of surgery, since more number of feet had good to excellent outcome who had previous cast treatment (92.3%)in comparison to feet who had no prior cast application (67%). Similar results were observed in other studies also [12-16]. As per the Green Lloyd-Roberts criteria, in our series 13 (37%) feet had excellent results, 13 (37%) feet had good results and 9 (25%) feet had poor results. We further found that Pirani scoring system is good method for clinical assessment of deformity. The patients who have low Pirani score at initial visit (less severe deformity) respond better and faster to the procedure as compared those who have higher scores.

Soft tissue release done is unsatisfactory in cases presenting too late for treatment, i.e. when the bony changes occur and there is alteration in the tarsal bones [2,9]. Sharma on assessment of initial and final Pirani scoring revealed significant improvement in all age groups but with mean difference of correction higher among more than 6 months' age [14]. We also found the mean correction of preoperative Pirani score was highest in the age between 6 months to 2 years as compared to 2 to 3.5 years or 3.5 to 5 years. This is because soft tissues are less resistant and more resilient to correction at young age and as age advances soft tissue structures and cartilaginous bone develop, remodels and becomes stiffer.

The complications in our series were wound gaping or superficial infection (n=6) and cast sore (n=4), all of which are minor complications, which can be easily dealt with regular dressings as we did. Although, the incidence of these complications were higher in our series, because, ours is hot and humid climate causing increased changes in skin and

soft tissue. Although we corrected all the components of the deformity i.e. adduction, varus and equinus completely on the table by complete posterior medial soft tissue release but mild forefoot adduction (9%) was most common residual deformity followed by hind foot varus (3%) in our series, as also seen by other studies by Menezes et al [12], Hussain et al [16] and Singh et al [18].

Dobbs et al concluded that clubfoot treated with an extensive soft-tissue release have poor long-term foot function [19]. Van Gelder et al noted CTEV cases after surgery have limitation of foot function with a significant decrease in range of motion and increases grade of osteoarthritis than contra lateral normal feet [20]. But our study is limited by short term follow up, and short sample size, hence a long term study with large cohort is suggested to evaluate this finding.

Conclusion

We found that good to excellent short term results can be obtained with one stage posteromedial release, in rigid, relapse, resistant or neglected CTEV. The poor results are due to late presentation or without prior casting treatment. Improved surgical results can be obtained by prior cast treatment, surgery between 6 months to 2 years' age, complete single stage soft tissue release and regular checkups for earlier identification of complications if any.

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Ponseti Technique In Children With Idiopathic Club Foot Presenting After 1 Year Of Age: A Retrospective Study

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Study performed at Department of Orthopaedics, Shyam Shah Medical College, Rewa (M.P.)

Abstract

Background: Ponseti method is accepted as gold standard treatment for idiopathic clubfoot in infants. However, very few studies are available in literature on use of Ponseti method in older children. The aim of this study is to determine the effectiveness of Ponseti technique in the treatment of late presenting congenital idiopathic club foot (CTEV).

Material & Methods: We retrospectively evaluated the results of ponseti method of serial casting in 23 patients with 32 clubfeet (15 males and 8 females) presenting after the walking age by using Pirani score. Quantitative variables were expressed as mean ± standard deviation and compared between initial and last follow-up scores using the paired t-test.

Results: The mean age at presentation was 3.4 (range 1 to 15) years and mean follow up was 14.2 (range 6 to 21) months. The mean pre-correction Pirani score improved from 4.51 (range 2.5 to 6) to 0.55 (range 0 to 1) after treatment, respectively which was statistically significant ($p < .001$). In 95% of the feet, satisfactory correction of the deformity was achieved. The mean number of casts applied was 9.2 (range 6 to 16).

Conclusion: The Ponseti technique is an effective method for the management of idiopathic clubfoot, even in older children up to 15 years of age.

Keywords: Clubfoot, Ponseti method, Pirani score, Neglected CTEV

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Introduction

Club foot (CTEV) is among one of the most common congenital musculoskeletal defects [1]. With the introduction of the Ponseti method, treatment of congenital club foot has changed radically in most centers worldwide in favour of serial casting. However, most of these studies on Ponseti method are done in younger children, before the walking age [1,2].

Late presentation of CTEV child after walking age, is a common problem in developing countries like ours due to social stigma, lack of education, poverty and lack of proper health services [3,4]. These neglected cases when present late, after walking age are complicated by severe deformities, contractures, deformation of bones, callosities and ulcers [5]. The conservative treatment becomes difficult. In the past decades many extensive soft tissue and bony surgeries have been performed to treat such deformities of neglected cases, but the results were not very promising. Additionally, surgeries were associated with many complications such as poor soft tissue healing and higher relapse rate. This results in significant disability, dependency of patient for activities of daily

living, financial and psychological impact on the family and finally many of these patients with neglected clubfoot deformity end up living as beggars on the streets [3,4].

Inspired by some studies which showed excellent role of Ponseti method even in late presenting walking patients of club foot [6-9], we retrospectively analyzed the results and role of Ponseti method of serial casting in neglected club foot deformity, done in the clubfoot clinic of our institution.

Material and Methods

We retrospectively analyzed the records of club feet cases who had been treated by Ponseti method in the club foot clinic of our institute from April 2016 to March 2019. Only neglected cases of CTEV i.e. presenting late after the walking age or one year with idiopathic club foot, with no previous treatment were included in the study. Secondary club foot, atypical clubfoot, non-healing ulcers, previously treated or prior surgeries done were excluded from the study. 29 cases were found eligible to be included in the study, but 6 cases were lost to follow-up after initial correction and were not available with complete follow up and hence were excluded from the study. Thus finally, only 23 cases of neglected CTEV were included in the study.

All the parents of club feet children had been found to be informed about the treatment protocol and they consented to be included as a subject in any study done by the institution. Institutional ethical committee approval was obtained.

All the patients were evaluated pre-treatment and at each visit by Pirani scoring system [10] and were treated weekly with Ponseti's method of serial manipulation and above knee plaster cast application [2]. The feet were manipulated for approximately 10 minutes before plaster cast application. The casting continued till foot abduction to approximately 30° to 40° was achieved (instead of 70°) which is recommended for elder child [11]. Finally, the equinus deformity was corrected by a percutaneous Achilles tenotomy in all patients irrespective of the age, followed by casting with full correction. The tenotomy in younger children was performed under local anesthesia. Spinal or general anesthesia was preferred in older children as more manipulation was expected in these cases due to presence of a more rigid equinus and cavus deformity. A repeat tenotomy of tendo-achilles was done in children where adequate dorsiflexion, i.e., at least 5^0 of dorsiflexion was not achieved by the first tenotomy. In few patients percutaneous plantar fascitomy was needed to correct the residual cavus deformity.

Post-tenotomy cast was removed at 3 weeks in patients aged less than 3 years and 4 weeks in patients aged more than 3 years. After the deformity was corrected, a foot abduction brace was prescribed to all patients for next one year. Initially the brace was worn for 23 hours a day for the first 3 months and after that brace wearing was advised for night time only.

Retrospective data was collected and analyzed forage at the time of presentation, severity of deformity by the Pirani score at initial presentation, change in the Pirani score after the final cast, the number of casts required to achieve full correction and any complications during the casting or bracing phase of the treatment. The quantitative variables were expressed as mean ± standard deviation and compared between preoperative and postoperative follow-up using the paired t-test. Statistical analysis was performed and a $P< 0.05$ was considered statistically significant.

Results

Out of 23 cases of CTEV who presented after 1 year of age, 9 had bilateral involvement whereas 14 had unilateral deformity (32 club feet). There were 15 male and 8 female patients.

The mean age at presentation was 3.4 (range 1 to 15) years. The mean pre-correction Pirani score was 4.51 (range 2.5 to 6). The mean post-correction Pirani score was 0.55 (range 0 to 1). This difference was statistically

significant ($p < .001$). The mean number of casts applied to achieve final correction was 9.2 casts (range 6 to 16 casts). In 95% of the feet, satisfactory correction of the deformity was achieved (fig 1& 2). The mean follow-up duration was 14.2 (range 6 to 21) months. A percutaneous Achilles tenotomy was performed in all patients with a mean ankle dorsiflexion after tenotomy of 7° (0° to 10°).

Fig 1. Pre (a) and post (b) treatment clinical photograph of 4 years old child of neglected bilateral CTEV treated by Ponseti casting.

a b

Fig 2. Pre (a) and post (c & b) treatment clinical photograph of 15 years old child of neglected CTEV left side treated by Ponseti casting. Lateral X ray of ankle with foot (d) showing deformed bones, although the foot is corrected clinically.

a b c & d

Complications noticed during the casting phase were mild and manageable. Four patients developed erythema, slight swelling of the toes and redness of the skin due to excessive pressure. Dynamic supination was present in four feet, but caused minimal disturbance of gait and hence was not operated. No infections, skin necrosis, neurovascular compromise or profuse bleeding after tenotomy were observed. No problems with healing were seen after the tenotomy, even in the oldest patient with age 15 years. Repeat Achilles tenotomy was done in 10 feet due to incomplete initial correction of equinus in 4 and recurrence of equinus in 6 feet. All of the parents were satisfied with the treatment offered to their child as appearance of the feet had improved and children were able to wear normal shoes for the first time in their lives and were able to walk plantigrade.

Discussion:

Neglected clubfoot is a common problem in developing countries due to lack of awareness, poverty and lack of proper medical facilities. It causes considerable physical, social, psychological and financial burdens on the patient and their families. Adults with untreated club feet can experience pain and disability, and have difficulty in finding a job [3-5]. The treatments of neglected clubfoot in the past have been extensive soft tissue release surgery, osteotomies, various types of fixators or arthrodesis. Long term studies of these surgical procedures have shown poor results with complications like painful feet, arthritis, joint stiffness and residual deformity [11-15].

Ponseti method has currently been the gold standard in treatment of CTEV, especially in infants. A few studies have shown promising results evaluating the use of Ponseti method in children with neglected clubfeet [6-9,16]. We have been treating all age group CTEV deformities at our clinic by Ponseti method and inspired by results of these studies, we retrospectively analyzed our results of Ponseti casting in 32 neglected club feet (23 children) with mean age of 3.4 years. In our study, with mean number 9.2 (range 6 to 16) cast, we were able to correct mean pre-treatment pirani score of 4.51 to 0.55 in these neglected CTEV cases with ponseti method of casting in mean follow up period of 14.2 months, which was statistically significant ($p < .001$). In 95% of our feet, satisfactory correction of the deformity was achieved, with all patients

having painless, plantigrade, and cosmetically acceptable feet. It was also observed that percutaneous Achilles tenotomy, which was done in all cases, healed uneventfully even in oldest patient with 15 years' age.

Lourenço and Morcuende treated 17 patients (24 feet) with neglected clubfeet, with mean age of 3.9 years and found good results in 16 feet (66.6%) [6]. Verma et al also found Ponseti method to be very effective in correction of CTEV deformity in toddlers [7]. Khan and Kumar treated neglected clubfoot in 21 children (25 feet) over 7 years' age and found good results in 18 feet (85.7%) [8]. Sinha et al treated 41 clubfeet in 30 patients with mean age of 3.02 years and were able to correct all the feet but in 17% equinus recurred [16]. In our study also, 18.75% (6 feet) feet had recurrence of equinus deformity which was managed by repeat percutaneous Achilles tenotomy without any open soft tissue release surgery. This is because in older children while manipulation and casting, dorsiflexion is most difficult to achieve and hence residual equines persists, which may require repeat tenotomy, especially in older children more than 7 years' age [7].

The mean number of cast (9.2 cast) to correct the deformity in our series was higher than the number as suggested by ponseti (5.2 cast). But this was obvious because, Ponseti mentioned this mean number of cast for correction of CTEV cases when presenting at less than one-year age whereas we treated neglected CTEV cases presenting after walking age of one year. The mean number of casts in our series was comparable to series by Lourenço and Morcuende (9 biweekly cast), Khan and Kumar (12.1 casts) and Verma (10 cast) [6-8].

It was also observed that in these older children, the feet could not be abducted beyond 40°, as has been advised 70° in younger children. This is because as towards the skeletal maturity, there is poor bone remodeling from deformed state and hence achieving full bony correction by soft tissue manipulation is difficult and not possible. Hence although foot seemed normal shaped externally, but bone could not remodel fully and are seen irregular on X rays, which also is cause of persistence of small sized foot (fig 2). Even Lourenço and Morcuende in their study mentioned that abduction was attempted to approximately 30–40° instead of 70° as recommended in infants [6].

We have also observed that above knee plaster casts and abduction brace were poorly tolerated especially by older children that could have been a risk factor for noncompliance and failure of treatment, but this issue had been dealt with proper parent's education and counseling. A retrospective study and lesser number of patients are limitations of our study.

Conclusion

Presentation of neglected club foot at a later stage after walking age of patient is common in our country, but even in these cases Ponseti`s method is a safe, effective and inexpensive method for treatment, although the mean number of cast may be higher and fully abduction of 70° cannot be achieved.

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Philos Plate For Fixation Of Supracondylar Dome Osteotomy

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Study performed at Central Institute of Orthopaedics, VMMC & Safdarjung Hospital, New Delhi

Abstract

Background: Various corrective osteotomies and different modes of fixation have been described to correct genu valgum deformity. We evaluated the results of dome osteotomy for genu valgum which was stabilized with proximal humerus internal locking system (PHILOS) plate.

Material & Methods: 39 cases of Genu Valgum deformity in 24 patients treated by dome osteotomy and fixed with PHILOS plate (15 patients had bilateral deformities and 9 patients had unilateral deformity) were evaluated clinically (intermalleolar distance and tibio-femoral angle) and radiologically (tibio-femoral angle).

Results: Pre-operative mean intermalleolar distance, clinical tibio-femoral angle and radiological tibio-femoral angle pre-operatively improved from 17.5 cm (range 11 to 24), 19.25^0 (range 14^0 to 24^0) and 20.9^0 (range 15^0 to 26^0) to postoperative 2.25 cm (range 0 to 4 cm), 7.75^0 (range 4^0 to 10^0) and 8.95^0 (range 5^0 to 11^0) respectively. The mean pre-operative LDFA was 74.85^0 (range 67^0 to 83^0) whereas post-operative mean value was 86.9^0 (range 83^0 to 90^0). The mean Bostman knee score improved significantly from 20.8 (range 18 to 22) to 29.1 (range 27 to 30). 2 patients (2 limbs) had good score i.e. between 20 to 27, while rest all the patients had excellent score between 28 to 30. Improvement in intermalleolar distance, tibio-femoral angle and LDFA was statistically significant ($P< 0.001$)

Conclusion: Dome osteotomy with PHILOS plate fixation is reasonable cost effective, easy, available and viable option for treatment of genu valgum with excellent short to midterm results and without complication as seen by wedge osteotomy.

Keywords: Genu Valgum, Dome Osteotomy, PHILOS plate

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Introduction

Genu valgum is a common deformity in childhood which may originate from the distal femur, proximal tibia or the knee joint, but it usually originates from the distal femur, which may be confirmed by clinical examination as well as by various angle measurements on radiographs [1,2]. Although deformities up to the age of 12 years can be corrected by epiphysiodesis with stapling, mini-plate or external fixator, but when the patient presents after physeal closure, corrective osteotomy is the treatment of choice [3].

Various types of corrective osteotomies of the distal femur have been described in the literature which includes lateral opening wedge, medial closing wedge, dome osteotomy, wedge-less spike osteotomy, and wedge-less 'V' osteotomy [4-14]. Dome osteotomy, in which, circular bone cuts are made, allows deformity correction and overcomes complications associated with wedge osteotomy like length discrepancy,

fragment mismatch, delayed union or segment translation. These advantages have made dome osteotomy the standard treatment, but the choice of implant to stabilize the osteotomy is debatable. Wide ranges of fixation methods have been tried, ranging from cast, k wires and external fixator to plates [15-20]. We evaluated the results of dome osteotomy for genu valgum stabilized with proximal humerus internal locking system (PHILOS) plate.

Material and Methods

This prospective study was performed at our center from May 2015 to May 2017 in 39 cases of Genu Valgum deformity in 24 patients treated by dome osteotomy and fixed with PHILOS plate (15 patients had bilateral deformities and 9 patients had unilateral deformity).

All the patients were selected from the outpatient department of our institute considering the inclusion criteria and were scrutinized through clinical assessment, radiological and biochemical investigations. The patients with genu valgum deformity with age more than 15 years having a tibio-femoral angle of more than 15^0 and an intermalleolar distance (IMD) of more than 10 cm were included in the study. Patients with 2-year minimum follow up were only included in the study. Patients who had unstable knee with evidence of subluxation, severe collateral ligament instability, and sagittal plane deformity (fixed flexion deformity) or genu recurvatum were excluded from the study.

All patients were investigated for metabolic and developmental disorders. Preoperative deformity assessment was done clinically (intermalleolar distance and tibio-femoral angle) and radiologically (tibio-femoral angle). Clinically the intermalleolar distance was measured in a standing position with the patella facing forward, the knees extended and the medial surface of the knees touching each other. Clinical tibio-femoral angle was assessed by measuring the angle between the line drawn from the anterior superior iliac spine to the center of the patella and the line joining the center of the patella to the center of the ankle joint. Radiological assessment was done on full length standing anteroposterior radiographs of the affected limb including the hip, knee and ankle joint (fig 1). The radiological tibio-femoral angle was measured as angle formed between the anatomical axes of tibia and femur. The lateral distal-femoral angle (LDFA) was defined as the angle between the mechanical axis of the femur (line from center of femoral head to center of knee joint) and the articular surface of the distal femur.

Patients who were considered suitable for surgery underwent a deformity correction by a supracondylar femoral dome osteotomy, with fixation of osteotomy using the PHILOS plate. All patients were operated under spinal anesthesia in supine position with tourniquet on a standard operating table. The knee was kept flexed, with the help of a sand bag. An ECG electrode was fixed on the skin overlying the center of the femoral head that was confirmed by image intensifier. A 10 cm long incision was made over the anterolateral aspect of the distal one third of thigh extending to superolateral border of the patella and whole of anterior supracondylar region of femur was exposed by developing plane between rectus femoris and vastus lateralis and splitting vastus intermedius. The dome was marked using a divider, which could be fixed at a particular radius. One limb of the divider was kept over the CORA (center of rotation of angulation), which was at the center of knee joint or femoral condyle level in all cases. This point corresponds approximately to the lower border of patella with the knee in full extension, and after correlating this point with the joint line, one limb of the divider was sunk into this part of patella and the radius of the dome was adjusted about 5 mm proximal to the adductor tubercle. An arc was now drawn over the lower femur. Multiple drill holes were made antero-posteriorly over the marked dome, perforating both femoral cortices. The dome osteotomy was completed by joining the drilled hole using a thin osteotome (fig 2a). Care was taken to keep the knee flexed so that neurovascular structures fall away. Now by holding the upper leg and keeping the knee

straight, the distal fragment was rotated at the osteotomy site thereby correcting the deformity. In some cases, the medial most portion of the proximal fragment hampered the rotation of distal fragment. A triangular bony projection was occasionally removed from this area to facilitate rotation, in these cases. The alignment was checked using a telescopic rod (Fig 2b) about 1-meter-long so that center of hip, knee and ankle become co-linear. The osteotomy was temporary fixed with a K wire or steinman pin percutaneously for provisional stability anteromedial to posterolaterally. Following this, osteotomy was fixed using appropriate length PHILOS plate applied laterally (fig 2c). Stability as well as the correction was confirmed intra-operatively under image intensifier. After applying a suction drain, the surgical wound was closed in layers.

Postoperatively, a long knee brace was applied intermittently for 4 weeks, and was be removed during range of movement exercises which were started from third day. The drain was removed at 24-48 hours after surgery and the amount of blood collected in the drain was noted. Sutures were removed at 2 weeks. Knee range of motion and quadriceps exercises started from third postoperative day. By using two axillary crutches patient was allowed ambulation, but no weight-bearing was permitted for the first 3 weeks. This was followed by toe-touch walking for 3 weeks, and further one axillary crutch was used for the next month with gradual transition to full weight-bearing as per tolerance. Patients were followed up regularly at 4 weeks, 12 weeks, 6 months, 12 months and 24 months' post-surgery.

Postoperatively, the patients were re-evaluated clinically and radiologically for the alignment, correction achieved, range of motion at knee and union of the osteotomy. Intermalleolar distance, tibio-femoral angle and lateral distal-femoral angle (LDFA) were calculated. Functional outcome was evaluated by Bostman knee score and patients with score between 28 to 30 were classified as having excellent outcome, a score between 20 to 27 was good and a score below 20 was classified as unsatisfactory. Statistical analysis was done by student's t-test between values obtained preoperatively and postoperatively and two-tailed $P < 0.05$ was considered statistically significant.

Results

39 osteotomies were carried out on 24 patients of genu valgum. 15 patients had bilateral deformities whereas 9 patients had unilateral deformity. The average age at operation was 16.01 years (range 14 to 20). There were 16 females and 8 males.

The mean intermalleolar distance pre-operatively was 17.5 cm (range 11 to 24), which postoperatively improved to 2.25 cm (range 0 to 4 cm). The mean pre-operative clinical tibio-femoral angle was 19.25^0 (range 14^0 to 24^0) and radiological tibio-femoral angle was 20.9^0 (range 15^0 to 26^0) which postoperatively improved to mean value was 7.75^0 (range 4^0 to 10^0) and 8.95^0 (range 5^0 to 11^0) respectively. The Mean pre-operative LDFA was 74.85^0 (range 67^0 to 83^0) whereas post-operative mean value was 86.9^0 (range 83^0 to 90^0). The mean Bostman knee score improved significantly from 20.8 (range 18 to 22) to 29.1 (range 27 to 30) (table 1). 2 patients (2 limbs) had good score i.e. between 20 to 27, while rest all the patients had excellent score between 28 to 30. Improvement in intermalleolar distance, tibio-femoral angle and LDFA was statistically significant ($P< 0.001$). All the patients were happy with the cosmetic correction except one and none of the patients complained of any hardware prominence. All patients regained 90^0 knee flexion within 2 weeks of surgery and almost full ROM at 3 months after the surgery except one patient, who had deep infection at the incision site, which responded to antibiotics and healed in 3 months (fig 3). One patient with epiphyseal dysplasia complained of pain in the knees and in spite of a good cosmetic correction was not happy. Four knees had slightly hypertrophic scars.

Discussion

Genu valgum in adolescents and young adults is a frequent cause of orthopaedic referral [1-3]. The abnormal biomechanical loads on the

Table 1. Pre-operative and post-operative clinical and radiological parameters

Parameters (n=39)	Preoperative	Postoperative	P
Intermalleolar distance in cm (range)	17.5±2.2 (11-24)	2.25±0.7 (0-4)	<0.001
Clinical tibiofemoral angle (range)	19.25±2.1 (14-24)	7.75±0.8 (4-10)	<0.001
Radiological tibiofemoral angle (range)	20.9±2.1 (15-26)	8.95±0.8 (5-11)	<0.001
Lateral distal-femoral angle (range)	74.85±2.1 (67-83)	86.9±0.6 (83-90)	<0.001
Boatsman knee score (range)	20.8±1.3 (18-22)	29.1±0.6 (27-30)	<0.001

Fig 1. Preoperative clinical photograph (a) and full length antero-posterior X rays (b) of the patient which shows genu valgum deformity.

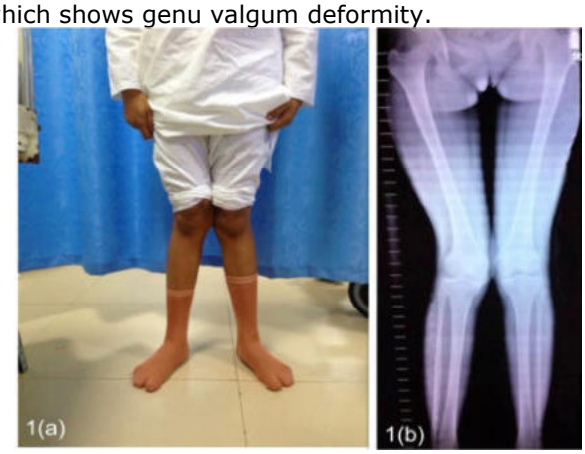
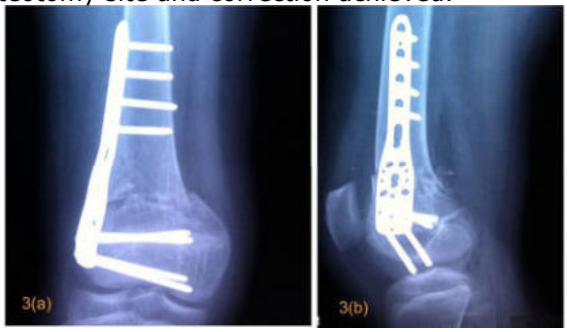


Fig 2. Intraoperative photo (a to c) of a patient of genu valgum with dome osteotomy & provisional fixation with K wire, alignment rod to check the correction & osteotomy stabilized by PHILOS plate.

Fig 3. 12 weeks postoperative antero-posterior (a) and lateral (b) radiograph of knee showing union at osteotomy site and correction achieved.



knee due to lateralization of the mechanical axis in genu valgum may lead to anterior knee pain, patello-femoral instability, circumduction gait, and difficulty in running [4-11]. Hence surgical intervention is needed to improve the biomechanics, which results in improved appearance, gait and function in significant valgus deformity [3]. Deformity correction in the coronal plane may be achieved using realignment osteotomies like lateral opening wedge, medial closing wedge, dome osteotomy, wedge-less spike osteotomy, and wedge-less 'V' osteotomy [4-14], which can be fixed with k wire, external fixators or plate [15-20]. This realignment osteotomy corrects the limb alignment and decreases the risk of arthritis development and progression [21-23].

We evaluated the results of 39 cases of dome osteotomy for genu valgum in 24 patients (15 bilateral and 9 unilateral) with mean age of 16 years, which were stabilized with proximal humerus internal locking system (PHILOS) plate and found statistically significant improvement in intermalleolar distance, tibio-femoral angle and LDFA, post-operatively.

Dome Osteotomy (DO) is a cylindrical osteotomy with corresponding bone cuts, which rotate around the central axis of a circle with no bone resection, which ensures no limb length discrepancy. When this central axis corresponds with the Centre of rotation of axis (CORA), correction of the deformity can be attained without translation of the bone axes and it is then called as focal dome osteotomy [1-3]. We preferred dome osteotomy instead of a wedge osteotomy as closing wedge results in limb shortening whereas opening wedge results in delayed union with more restrictive weight-bearing (absent bone contact). The DO provides a large surface and maximizes bone contact, which results in optimal healing. Small bone spikes are produced by multiple drill holes after low-energy dome osteotomy. These small bony spikes interdigitate at the osteotomy site after acute deformity correction and provide additional stability. Not only it reduced

segment motion during osteotomy fixation but it also reduced the stress on the plate and screws, allowing early rehabilitation, range of motion and weight-bearing. The dome osteotomy also allows high degrees of correction in the coronal plane. The DO is technically demanding surgery because performing the osteotomy as an arc needs care, precision and expertise to maintain the circular contour to ensure perfect segment rotation and bone contact and to avoid inadvertent propagation.

Further, for osteotomy to be effective it is important that osteotomy should be done at CORA. In our study, the preoperative radiographic planning showed the CORA to be at the knee joint or femoral condyle level in all cases. This CORA was the center of the circle upon which the DO was created and hence it ensured a focal dome osteotomy and so we could achieve full correction with minimal translation of the distal bone fragment in all our cases.

Finding appropriate fixation device for supracondylar osteotomies in adolescent is relatively a tedious job and one needs to arrange for specialized pediatric angled blade-plates, angle-stable plates or intramedullary nails, which are costlier [2,11]. Seah et al found no significant differences in their comparative study of internal versus external fixation for distal femoral osteotomies, and concluded that the fixation method should be left to the discretion of the surgeon [24]. We used the adult Proximal humerus Interlocking System (PHILOS), routinely used in adult proximal humeral fractures to avoid more expensive and remotely available specialized pediatric implants while retaining its advantage of ability and contour which fits to match the desired correction. PHILOS provides advantages like no need for post-operative plaster immobilization, early rehabilitation hence decreases chances of knee joint stiffness and quadriceps atrophy and decreased chances of fixation loss hence decrease incidence of non-union at osteotomy site. In adolescents, the antero-posterior dimensions of the distal femur are not large enough to place a condylar buttress plate, but the PHILOS plate is reasonable wide and stable suitable for fixation until osteotomy union. Further, PHILOS plate is widely available and cost effective compared to customized paediatric plates which are expensive as well as availability is an issue in the developing countries. Although, the PHILOS plate is a relatively weak implant in comparison with the condylar buttress plate, but we found it to be sufficient for fixation in adolescents and we did not encounter any implant failure.

The most common, described complications following corrective angular osteotomies are non-union and failure of fixation [25]. Use of Dome osteotomy and PHILOS plate, in our study, provided good bone apposition and stable fixation which prevented these complications. Our study is limited by small number of cases, and relatively shorter follow up. Future studies involving a larger number of cases, longer follow ups and those comparing the use of plates with an external fixator may be useful.

Conclusion:

Correction of Genu valgum deformity by dome osteotomy via lateral approach, can be accomplished very well using PHILOS for fixation, without complication of wedge osteotomy. Being a cost effective and easily available implant, the PHILOS has encouraging results in short to mid-term follow up.

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A Comparative Study of Efficacy of Intra-lesional Dry Needling, Platelet Rich Plasma and Corticosteroid in Lateral Epicondylitis

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Abstract

Background: Lateral epicondylitis (LE) or Tennis Elbow (TE) is a common cause of musculoskeletal pain involving common extensor origin of the forearm with various treatment options available ranging from conservative, intra-lesional injection to surgical.

Material & Methods: 147 cases of recalcitrant Lateral Epicondylitis treated with intra-lesional dry needling (n=50), platelet rich plasma (PRP) (n=49) or corticosteroid (n=48) injections were compared for VAS and DASH score.

Results: The mean pre-injection VAS score in needling, PRP and steroid group improved from 67.48, 68.00 and 67.39 to 38.50, 36.37 and 36.85 at 24 weeks' post-injection respectively which was statistically significant ($p<0.05$). The mean pre-injection DASH score in needling, PRP and steroid group improved from 57.72, 56.96 and 56.19 to 32.04, 31.37 and 31.17 24 weeks' post-injection respectively, which was statistically significant with paired t test p value < 0.05.

Conclusion: All three procedures, intra-lesional dry needling, PRP and corticosteroid were equally effective in treating lateral epicondylitis, with improvement in both the functional as well as pain scores in long term, but immediate post procedural relief was found better in the corticosteroid group.

Keywords: Lateral epicondylitis, Tennis elbow, Corticosteroid, PRP, Needling.

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Introduction

Lateral epicondylitis or Tennis Elbow is a common cause of musculoskeletal pain involving common extensor origin at elbow, thought due to overuse of the Extensor Carpi Radialis Brevis (ECRB) muscle by repetitive micro trauma, which results in its primary tendinosis, with or without involvement of the Extensor Digitorum Communis (EDC) and Extensor Carpi Radialis Longus (ECRL) [1]. It is common in people whose occupation requires frequent rotatory motions of the forearm (plumbers, carpenters, tennis players)[2]. Clinically, a patient with tennis elbow has pain around the lateral elbow and forearm, which radiates toward the extensor region. Rotation, extension of forearm and grasp is reduced. Clinical testing reveals painful resistance against dorsiflexion of the wrist. The diagnosis of tennis elbow is mainly clinical and special tests like Cozen's test, Mill's maneuver or investigations like ultrasound, radiographic examination, MRI and electro-myophysiological testing are indicated when there is difficulty in establishing diagnosis, which can be helpful in identifying other causes of lateral elbow pain [3,4].

The condition is usually a self-limiting condition which resolves in 6–12 months regardless of treatment, but sometimes complaints may last longer [5]. There has been no consensus on the optimal management strategy for the condition and various modalities including the newer modalities like local injection of Platelet Rich Plasma (PRP), autologous blood, dry needling, prolotherapy and extracorporeal shockwave therapy are used with varied results [6-10].

Local steroid injection has been proven to provide consistent and predictable short term pain relief, but long term results are inconsistent [7].Tennis elbow, an angio-fibroblastic degenerative and inflammatory condition of the tendon, is benefitted by autologous PRP as it is a healing agent containing growth factors that build up reparative processes by angiogenesis, increase in growth factor expression, cell proliferation and increases the recruitment of repair cells and tensile strength [11-13].Dry Needling is used to treat myofascial pain and dysfunction, by deactivating the myofascial trigger points and releasing the taut band of muscle[14,15]. We evaluated and compared the short term effects of intra-lesional injection of dry needling, autologous platelet rich plasma and corticosteroid in patients of recalcitrant lateral epicondylitis.

Material and Methods

This prospective study was conducted at our center in patients of resistant lateral epicondylitis after proper patients consent and institutional ethical committee approval. Patients with clinical pain and tenderness at lateral epicondyle, with restriction of forearm rotation and positive Cozen and Mill's tests were diagnosed as cases with lateral epicondylitis. All these patients were initially given conservative treatment with analgesics, anti-inflammatory drugs and physiotherapy. Patients with resistant lateral epicondylitis between age 18 to 70 years not responding to conservative treatment for 3 months were included in the study. All patients with age less than 18 years and more than 70 years or had a chronic inflammatory disease like rheumatoid arthritis, uncontrolled diabetes, systemic hypertension, history of trauma to the elbow, prior history of injection at elbow or with infection at the injection site were excluded from the study.

Patients were sequentially randomized into three groups for intra-lesional corticosteroid injection, PRP injection and dry needling as 1st patient was given corticosteroid injection, 2nd was given PRP injection, 3rd patient underwent dry needling and 4th patient underwent corticosteroid injection and so on.

All injections were done using strict sterile precautions, with no touch technique with sterile needles. Area was cleaned with povidone iodine followed with chlorhexidine solution and point of maximum tenderness was marked using sterile marker. Injection was given on this point of maximum tenderness using peppering technique i.e. single skin entry, partially withdrawing the needle without emerging the skin, slightly redirecting and reinserting.

a. Corticosteroid injection – 40 mg triamcinolone (Kenacort) mixed with 2 ml of 2% lidocaine was used.
b. Platelet Rich Plasma injection–27 ml of autologous blood was taken with 3ml of sodium citrate in a vaccutainer, which was centrifuged for 15 min at 3200 revolutions per minute. The plasma portion of the centrifuged mixture was discarded and the PRP portion so harvested was buffered with 8.4% sodium bicarbonate, to increase the pH to normal physiological levels. 2 ml of PRP was obtained and injected at most tender point.
c. Dry Needling - Five 0.25 × 25-mm stainless steel needles in the trigger point regions were inserted, directed through the skin and fascia to the bone (3–5 mm). They were rotated three to four times and left in place for ten minutes. Applications were repeated twice per week for a total of five sessions.

Post injection, all the patients were given ice fomentation, non-steroidal anti-inflammatory drugs and advised against massage or hot fomentation. Clinical outcome was measured by Disabilities of the Arm, Shoulder and Hand

(DASH) score and Visual analog scale (VAS) score.

Results

Total of 183 patients (61 patients in each group) enrolled for the study, but finallyonly147 patients of lateral epicondylitis formed the cohort since rest of the patients were lost to follow up. Out of these 48 patients were treated with corticosteroid injection, 49 with platelet rich plasma injection and 50 patients with dry needling. The demographic features of the patients are given in table no.1.

The mean pre-injection VAS score in needling, PRP and steroid group improved from 67.48, 68.00 and 67.39 to 38.50,36.37 and 36.85at 24 weeks post-injection respectively. There was a statistically significant decrease in the mean VAS score from pre-procedure level to 24 weeks in the Needling group, PRP group and Steroid group ($p<0.05$). The mean pre-injection DASH score in needling, PRP and steroid group improved from 57.72, 56.96 and 56.19 to 32.04, 31.37 and 31.17 24 weeks' post-injection respectively, which was statistically significant with paired t test p value < 0.05 (table no. 2). There was a statistically significant decrease in the mean DASH score from pre-procedure level to 24 weeks in the Needling group, PRP group and Steroid group ($p<0.05$). No significant statically difference was found in comparison of the group's results.

Table 1 - Demographic features of patients in needling, PRP and steroid groups (N=147)

Characteristics	Needling Group (n=50)	PRP Group (n=49)	Steroid Group (n=48)
Mean age(range)in years	43.40 ± 8.38(30-67)	45.32 ± 8.31(30-67)	44.76 ± 6.41(33-65)
Gender - Female / Male	32(64%)	26(54%)	34(72%)
	18(36%)	23(46%)	14(28%)
Side - Left / Right	17(34%)	8(16%)	17(34%)
	33(66%)	41(84%)	31(66%)
Mean duration of symptoms± SD (Range) in months	4.43 ± 1.27 (2-8)	4.60 ± 1.33 (2-7)	4.44 ± 1.15 (2-8)

Table 2 - Comparison of mean VAS score and DASH score between different group

		Time Interval	Mean ± SD	't' value	P value
Needling group (50)	VAS score	Pre procedure	67.48 ± 3.73	51.527, df=49	0.001*
		24 weeks	38.50 ± 3.18		
	DASH score	Pre procedure	57.72 ± 5.95	27.825, df=49	0.001*
		24 weeks	32.04 ± 3.59		
PRP Group(49)	VAS score	Pre procedure	68.00 ± 5.05	30.552, df=48	0.001*
		24 weeks	36.37 ± 5.11		
	DASH score	Pre procedure	56.96 ± 5.83	23.088, df=48	0.001*
		24 weeks	31.37 ± 4.73		
Steroid group (48)	VAS score	Pre procedure	67.39 ± 6.26	33.118, df=47	0.001*
		24 weeks	36.85 ± 4.54		
	DASH score	Pre procedure	56.19 ± 7.03	18.926, df=47	0.001*
		24 weeks	31.17 ± 4.88		

Discussion

Lateral epicondylitis (Tennis elbow) remains one of the most perplexing disorders of musculoskeletal system, which is due to overuse or repetitive micro-trauma resulting in a primary tendinosis of common extensor origin, with pain and tenderness at lateral epicondyle along with limitation of elbow movements[1-3].Various treatments ranging from non-operative by rest, anti-inflammatory drugs, brace, physical therapy or by local intralesional injections or by surgical techniques, have been tried with varied results [6-10,16,17]. But there has been lack of knowledge regarding efficacy comparing different intralesional injections done for recalcitrant lateral epicondylitis. Hence we compared the outcome of intra-lesional dry needling, PRP and corticosteroid in 147 patients of resistant tennis elbow in almost comparable groups in terms of mean age (44

years), mean duration of symptoms (4.4 month), laterality (right preponderance) and gender (female preponderance), which was also almost same as with others studies by Raman et al, Sukumar et al, Madhuram et al [18-20].

In our series, mean pre-injection VAS score in needling, PRP and steroid group was from 6.74 ± 3.73, 6.8 ± 0.5 and 6.739 ± 0.62 respectively, while in Raman et al series it was 7.6 in PRP group and 7.7 in steroid group and 4.6 ± 0.94 in PRP group and 3.1 ± 1.09 in steroid group in Madhuram et al series [18,20]. 24 weeks' post-injection, the VAS in our series improved to3.85 ± 3.18, 3.67± 5.11 and 3.68± 4.54in needling, PRP and steroid group respectively while Raman et al had 1.6 in PRP group and 2.8 in steroid group and Madhuram et al had 1.15 ± 0.81 in PRP group and 0.90 ± 1.1 in steroid group, respectively [18,20].

DASH score in our study at the time of presentation was 57.20 ± 6.02 in PRP group, 56.70 ± 7.34 in steroid group and 57.72 ± 5.95 in needling group while Raman et al had 58.4 in PRP and 59.3 steroid group and Madhuram et al had 57.64 ± 6.34 in PRP group and 53.69 ± 5.62 in steroid group. DASH score at 24 weeks was 31.37 ± 4.73 in PRP group, 31.17 ± 4.88 in steroid group and 32.04 ± 3.59 in needling group while Raman et al had 34.16 in PRP group and 44.33 in steroid group and Madhuram et al had 31.95 ± 2.65 in PRP group and 31.79 ± 1.67 in steroid group [18-20].

In our study, all three procedures were equally effective in treating lateral epicondylitis, with improvement in both the functional level as seen by improvement in DASH score as well as significant decreases in the pain as seen by significant improvement in VAS score. This improvement was comparable to other studies. Since none of other studies had compared dry needling with intralesional corticosteroid and PRP, we on compared the results of dry needling, PRP and corticosteroid and found no major statistical difference in all 3 groups, with all the procedures equally effective at final outcome. But immediate post procedural relief was found better in the corticosteroid group as the VAS and DASH score reduced more as compared to the other two groups. However, small cohort and lesser duration of follow-up are short comings of our study and long term studies are required for choosing the best modality.

Conclusion

Tennis elbow is primarily a condition common in middle aged patients with female preponderance and all three procedures, intra-lesional corticosteroid, dry needling and PRP were equally effective in treating lateral epicondylitis, with improvement in both the functional as well as pain scores in long term, but immediate post procedural relief was found better in the corticosteroid group.

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Functional Outcome of Comminuted Clavicle Fracture Treated With LCP: A Prospective Study

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Study performed at Department of Orthopaedics, R. D. Gardi Medical College, Ujjain (M.P.)

Abstract

Background: Fractures of clavicle are very common injuries, which have been traditionally treated non-operatively but has shown increased rate of malunion and nonunion. Operative fixation of clavicle fracture prevents these complications. Hence to validate this we evaluated the outcome of locking compression plate in treatment of comminuted middle third clavicular fractures.

Material & Methods: 25 cases of closed comminuted middle third clavicular fracture between 18 to 60 years were treated surgically with open reduction and internal fixation with locking compression plate and were assessed radiologically for union and functionally by Constant and Muller score.

Results: All 25 patients of comminuted midshaft clavicle fracture with mean age 28.3 years united in mean duration of 13.2 weeks. As per Constant and Muller score, 18 patients (72%) had excellent functional outcome, good in 5 patients (20%), fair in 2 patients (8%) and none of the patients had poor outcome. 3 patients developed hypertrophic skin scar, 2 patients had plate prominence and in 1 patient superficial infection occurred.

Conclusion: Mid third clavicle fractures treated by locking plate achieve reliable bony union and provides a more rigid stable fixation which does not require immobilization for longer periods. It results in earlier return to functional outcome and improved patient and surgeon results, with decreased rates of nonunion and malunion.

Keywords: Clavicle, Comminuted Fracture, Locking Compression plate

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Introduction

Clavicular fracture accounts for approximately 5% to 10% of all fractures and up to 44% of injuries to the shoulder girdle [1,2]. About 70% to 80% of these fractures are in the middle third of the bone, followed by the lateral third (12% to 15%) and the medial third (5% to 8%) [3-5]. This higher incidence is because midshaft clavicle has the thinnest segment of bone which is not stabilized by ligaments [6-8].

A direct blow on the shoulder is the commonest mode of injury that causes fracture of the clavicle. These clavicle fractures have been traditionally treated non-operatively, which has shown poor outcomes with increased rate of malunion and nonunion [6,8-10].

Operative fixation of clavicle fracture prevents these complications and provides increased patient satisfaction, early pain relief, rehabilitation and better functional outcome [11]. Recent studies have reported high success rates after primary operative fixation with union rates ranging from 94% to 100% and low rates of infection and surgical complications [12,13]. To validate this better

functional outcome of clavicle fracture with surgical treatment we evaluated the outcome of locking compression plate in treatment of comminuted middle third clavicular fractures.

Material and Methods

This study was conducted in our institute between Dec 2017 to Dec 2019 on 25 patients of mid-third clavicular fracture, attending our emergency or OPD department. Institutional ethical committee approval and informed written consent from all the patients was obtained. Closed comminuted middle third clavicular fracture patients aged between 18 to 60 years with no medical contraindication for surgery were included in the study. Skeletally immature patient, open or pathological fracture and associated with other injuries were excluded from the study.

Plain radiograph of clavicle along with shoulder in antero-posterior view was taken to assess the site and type of fracture. Routine investigations were done and fitness for surgery was obtained. All patients were operated in supine position under general anesthesia via anterior approach fixing the fractured middle third clavicle with appropriate size locking compression plate. Postoperatively, analgesic and antibiotics were continued, with dressing on 2nd day and suture removal at 2 weeks was done. The involved limb was supported by arm pouch. Intermittent exercises, with gentle pendulum exercises were started from 3rd day. Gradually full active range of motion in all the planes was achieved till 4 to 6 weeks. Patients were followed regularly at 2, 4, 8 and 12 weeks and monthly thereafter. Patients were assessed clinically as well as radiologically. X-rays were taken at each follow-up to see progressive fracture union and implant position. The functional outcome was assessed by Constant and Murley score [14].

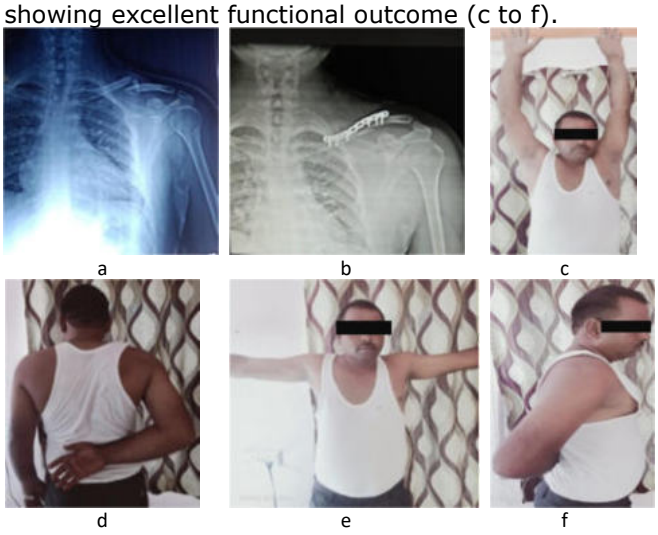
Results

25 patients of comminuted midshaft clavicle fracture, with mean age 28.3 years (range 21 to 44) were included in study, of which 20 patients (80%) were male and 5 (20%) were females. 18 patients (72%) had left sided fracture, whereas 7 patients (28%) had right sided fracture.10 patients (40%) sustained trauma due to fall on outstretched hand and 15 (60%) were due to road traffic accident. All patients except one were operated within 5 days after the injury, whereas one patient was operated with delay of 8 days after injury.

All fractures united at mean duration on 13.2 weeks, with 20(80%) patients united at 12 weeks and 5(20%) patients united at 15 weeks. As per Constant and Murley score, 18 patients (72%) had excellent functional outcome, good in 5 patients (20%), fair in 2 patients (8%) and none of the patients had poor outcome (fig 1).

03 patients (12%) developed hypertrophic skin scar and in 2 patients (8%) plate prominence occurred. 1 patient (4%) had superficial infection, which healed after antibiotics.

Fig 1. Pre operative (a) and immediate post-operative (b) antero-posterior x rays of a 40 years' male with clavicle fracture who was operated with locking plate. 6 months follow up clinical pictures showing excellent functional outcome (c to f).



Discussion

Clavicle fractures are among the most common fractures of young age group, which account for 5% of all fractures and 44% of all shoulder fracture injury [1,2]. Middle third is most common involved followed by lateral and medial third [3-5]. High failure rates of conventional conservative treatment, along with increased understanding of fracture biomechanics of clavicle, had led to conclude that operative surgical management,

especially for fractures with comminution, gross displacement or shortening > 2 cm leads to good functional outcome and early mobilization of patients [12,13,15]. There are various modes for fixation of midshaft clavicle fractures, such as intramedullary K-wires, Steinmann pin fixation, flexible nails, external fixators or plate fixation [16]. Intramedullary nailing does not control rotation, so they require a longer period of immobilization till union as compared to internal fixation methods like plate fixation.

In order to validate this better outcome of surgical treatment of clavicle fracture by plate fixation, we evaluated the results of 25 cases of communited mid third clavicle fracture treated with locking compression plate with mean age of 28.3 years. The mode of injury, sex incidence, age range and type of fracture included in our study were comparable to studies done by Bostman and Pearson [15,16].

In our study, all fractures united at mean duration of 13.2 weeks, with more than 90% patients having excellent to good results and none of the patients had poor outcome. Although the mean time to union in our study was slightly more than the study by Lazarus, but it was comparable to other studies as by Bostman and Pearson et al [15-17].

Complications noted in our study were hypertrophic skin scar, plate prominence and superficial infection as seen in 3, 2 and one patients respectively, all of which were successfully treated conservatively successfully and none of the patients required implant removal. These complications were also comparable with other studies. Our study is limited by lack of randomized control, lower number of patients and short term follow-up.

Conclusion

Clavicle fractures, conventionally treated conservatively, may lead to suboptimal outcome specifically in comminuted, displaced midshaft and lateral third clavicle fracture. Mid third clavicle fractures treated by locking plate achieves reliable bony union and provides a more rigid stable fixation which does not require immobilization for longer periods. It results in early improved patient and surgeon-oriented, functional outcome, and decreased rates of nonunion and malunion.

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Etiology Of Avascular Necrosis Of Femoral Head In Population Of Malwa Region In Madhya Pradesh

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Study performed at Department of Orthopaedics, Sri Aurobindo Institute of Medical Science & Post Graduate Institute, Indore (M.P.)

Abstract

Background: Osteonecrosis is characterized by bone cell death following, decrease in blood supply to the bone due to traumatic or non-traumatic cause. We evaluated the etiology of osteonecrosis of femoral head in population of Malwa region of Madhya Pradesh.

Material and Methods: This longitudinal study was conducted from January 2018 to Jan 2020 in patients diagnosed with avascular necrosis of femoral head, which were evaluated, examined and investigated to know the etiology of the disease.

Results: 70 cases with mean age of 39 years (55 males and 15 females) were included. Bilateral involvement was seen in 20 (29%) cases, whereas 50 (71%) cases had unilateral involvement. Idiopathic AVN was most common cause of the osteonecrosis as seen in 27 (39%) cases followed by steroid induced AVN in 12 (17%), post traumatic in 13 (19%) cases, alcohol induced in 8 cases (11%), both alcohol and steroid induced in 2 (3%) cases and sickle cell anaemia was seen in 8 (11%) cases.

Conclusion: Our results showed that most common cause of osteonecrosis of femoral head in population of Malwa region of Madhya Pradesh is idiopathic followed by trauma, steroid induced and then alcoholism or sickle cell anemia. Most commonly affected people are in age group of 26-40 years with male preponderance. Appearance of disease is more, unilateral as compared to bilateral.

Keywords: Avascular necrosis, Osteonecrosis, Malwa region

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Introduction

Osteonecrosis (also known as avascular necrosis, ischemic necrosis, subchondral AVN, aseptic necrosis or osteochondritis dissecans) is characterized by bone cell death, which follows due to decrease in the blood supply to the bone from a traumatic or non-traumatic cause [1,2]. It is a disabling disease, which is characterized by death of the osteocytes and bone marrow, which is followed by resorption of the necrotic tissues and formation of new osseous tissue but weaker tissue than normal, which leads to destruction of bone architecture, subchondral fracture, loss of articular contour and collapse of joint, finally causing loss of the joint function [2-4]. This mostly occurs at the head of the femur.

The exact cause of AVN is still not fully understood but it is thought to be caused by multiple factors along with some genetic predilection. The causes of AVN can be traumatic or atraumatic [5-9]. We in this study tried to evaluate the causes of osteonecrosis of femoral head in the central part of India in patients presenting with hip pain at our institute.

Material and method

This longitudinal study was conducted from January 2018 to January 2020 in Orthopaedic department of our tertiary care hospital in metropolitan city of central India. Institutional ethical committee clearance and patients consent was obtained before the study. All patients diagnosed with avascular necrosis of femoral head (Ficat and Arlet stage I to IV), unilateral or bilateral with age more than 18 years of age were included in the study. Patients with age less than 18 years were excluded from the study.

All patients coming to OPD with hip pain were evaluated with X-rays of the pelvis AP view. X rays showing avascular necrosis of the head of the femur of any stage were included after they fulfilled the inclusion criteria. Patients included in the study were subjected to detailed history and thorough clinical examination. In patients with history of alcoholism, detailed information of the amount and duration of alcohol intake was recorded. In patients on steroids, precise information was obtained about the indication, duration and time after which symptoms occurred. In post-traumatic cases, the details of injury, duration and mode of injury, surgery/intervention and surgical procedure related information collected. The details of the diseases were obtained from the clinical records and these patients were rechecked to collect out any missing data.

The patients were evaluated radiologically with anteroposterior and lateral radiographs of the hip joint and staging of osteonecrosis of femoral head was done based on Ficat and Arlet classification. Functional score of patient was done by Harris hip score (HHS).

Routine laboratory investigations such as complete haemogram profile, renal function test, liver function test, lipid profile and coagulation profile (such as prothrombin time, clotting time) were performed for all patients. Patients with suspected condition or specific disease that might have led to osteonecrosis were further evaluated with specific laboratory and radiological investigations. Patients without any abnormalities were labeled as idiopathic. All the information so obtained was assessed and studied for the cause of AVN.

Results

A total of 70 patients were included in the study. Out of which 55 (79%) were male and 15 (21%) were female. Bilateral involvement was seen in 20 (29%) cases, whereas 50 (71%) cases had unilateral involvement. The mean age of the patients in the series was 39 years (19 to 63 years).

In the bilateral disease group, the most common etiology seen was idiopathic in 10 (50%) cases, followed by steroid in 5 (25%) cases, then alcohol in 3 (15%) cases. In the unilateral disease group, the most common etiology seen was idiopathic in 17 (34%) cases, followed by post traumatic after surgery as seen in 12 (24%) cases, then sickle cell and steroid use, each contributing to 7 (14%) cases. Overall, idiopathic AVN was most cause of the osteonecrosis as seen in 27 (39%) cases. This was followed by steroid induced AVN in 12 (17%), post traumatic in 13 (19%) cases, alcohol induced in 8 cases (11%), both alcohol and steroid induced in 2 (3%) cases and sickle cell anaemia as seen in 8 (11%) cases (table no. 1).

In the bilateral disease group, 11(55%) cases had never received any treatment whereas 4 (20 %) cases had history of treatment for 1 year, 1 (5%) case had treatment for 5 years, 2 (10%) had treatment history for 6 to 10 years and 2 (10%) had history of treatment for more than 10 years. In the unilateral disease group, 28(56%) cases had never received any treatment whereas 5 (10 %) cases had history of treatment for 1 year, 6 (12%) cases had treatment for 5 years, 6 (12%) had treatment history for 6 to 10 years and 5 (10%) had history of treatment for more than 10 years. In 8 patients who were consuming alcohol, the mean alcohol consumption in unilateral (3 cases) and bilateral patients (5 cases) was 520 ml/week (range 260–780 ml/week) and 926 ml/week (range 350–1850 ml/week), and mean duration of alcohol ingestion was 75 months and 88 months respectively.

Total 14 cases were on steroids (12 only steroids and 2 along with alcohol). Out of the

14 patients, 5 (36%) has Lichen planus, 4 (28%) has dermatitis, 2 (14 %) each had psoriasis and bronchial asthma and one case (7 %) had COPD. Among 12 cases of post-traumatic AVN, one case was posterior dislocation, whereas rest of the 11 cases had osteronecrosis after fracture neck femur.

Table no. 1: Distribution of patients according to etiology

Etiology AVN	Bilateral		Unilateral		Total	
	No.	%	No.	%	No.	%
Alcohol	3	15.0	5	10.0	8	11.4
Steroid	5	25.0	7	14.0	12	17.1
Alcohol and steroid	0	0.0	2	4.0	2	2.9
Idiopathic	10	50.0	17	34.0	27	38.6
Sickle Cell anaemia	1	5.0	7	14.0	8	11.4
Post traumatic	1	5.0	12	24.0	13	18.5
Total	20	100.0	50	100.0	70	100.0

Discussion

The major blood supply to the head of the femur comes from the medial and lateral circumflex branches of the profunda femoris, which is a branch of the femoral artery. The medial and lateral circumflex femoral arteries anastomose to form a ring around base of the neck of the femur (extrasynovial ring), from which retinacular vessels arise and ascend along the neck to form a subsynovial (intra-synovial ring) anastomosis. From this ring, many small arteries branch off to perfuse the femoral head. Another direct source of blood supply is from the foveal artery which is also known as the artery of the ligamentum teres [10]. The blood supply of the acetabulum comes mainly from the acetabular branch of the obturator artery, along with the contributions from pubic branches of the obturator artery and deep branches of the superior gluteal artery. Because of this limited collateral circulation and precarious blood supply by end arteries, disruption of the blood supply to the head of the femur as caused by fracture neck of femur or hip dislocation, can lead to ischemia and subsequent necrosis [11].

Atraumatic osteonecrosis of femoral head is a multifactorial disease which is associated with genetic predilection and exposure to certain risk factors such as chronic corticosteroid administration, chronic alcohol ingestion, smoking and various chronic diseases (renal disease, haematological disease, inflammatory bowel disease, post organ transplantation, hypertension and gout) [5-9]. Unsupervised use of steroid for long time and excessive alcohol consumption represent the bulk of non-traumatic etiologies. Despite evidence demonstrating the correlation between steroid use and osteonecrosis, the exact pathophysiology is still not clear. The cause is most likely a combination of factors such as emboli, fat cell hypertrophy leading to raised intraosseous pressure, endothelial dysfunction, hyperlipidemia and abnormality of the stem cell pool of the bone marrow, all of which contribute to ischemia and subsequent necrosis [12]. Alcohol-induced osteonecrosis is also not well understood but is most likely caused by stems from bone marrow fat cell hypertrophy and proliferation, serum lipid level changes, blood vessel occlusion, raised intraosseous pressure and subsequent lack of perfusion [13]. Sickle cell disease can be another cause of osteonecrosis. The rigid red blood cells formed by clumping of sickle shaped RBCs, hampers blood flow leading to ischemia and bony infarction, with the femoral head being the most common site [13]. Autoimmune and chronic inflammatory disorders, e.g., systemic lupus erythematous (SLE), are other well-known causes to be associated with osteonecrosis of the femoral head [14]. Traumatic cause of osteonerosis is femoral neck fracture or dislocation, which disrupts the blood supply to the head of the femur, leading to avascular necrosis.

We evaluated the causes of osteonecrosis of femoral head in 70 patients with mean age of 39 years presenting with hip pain at our institute and found that idiopathic is the most common cause of AVN in both unilateral and bilateral involvement. After idiopathic AVN, steroid and alcohol are most common cause of AVN in bilateral involvement, whereas traumatic involvement was most common cause in unilateral involvement. The most

common age group involved was 26 to 40 years and there was male preponderance, probably due to more alcoholic indulgence by males as compared to females in the Indian set up. These factors were in accordance with other studies, except for the fact that 71% were unilateral cases in our series whereas other series have unilateral cases in range 40 to 50%, alcohol induced AVN was 11.4% in our series while other studies have this range from 5 to 10% and steroid induced AVN in our series was found to be 17% while 6 to 10 % in other reported series [15-17].

Conclusion

Our results showed that most common cause of osteonecrosis of femoral head in population of Malwa region in Madhya Pradesh is idiopathic followed by operated case of trauma then steroid intake and then alcoholism or sickle cell. Most commonly affected people are in age group of 26-40 years with male preponderance. Appearance of disease is more in unilateral as compared to bilateral. In most of the patients after 30 days disease also appeared in opposite side. In our study 50% patients had modifiable cause so we concluded that disease can be prevented in 50% of patients.

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Tillaux Fracture In Adult: A Case Report

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Study performed at Rotherham District General Hospital, Rotherham, South Yorkshire, United Kingdom

Abstract

Case report

We report a rare case of Tillaux fracture of the ankle in a 36-year-old man. He sustained the injury in a football tackle and presented to us with pain and swelling of the left ankle. After preliminary X-rays, a CT scan was done which showed a Tillaux type fracture which is a rare injury after epiphyseal fusion. The ankle was treated with open reduction and internal fixation with screws and plaster for 6 weeks. At 3 months the patient had no pain in the ankle and able to mobilize full weight bearing on that side.

Keywords: Ankle fracture, Tillaux fracture, Anterolateral tibial avulsion

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Introduction

Tillaux fracture is an uncommon, rare ankle injury, described as an avulsion fracture of anterolateral part of distal tibia due to the stronger pull of the anterior tibiofibular ligament, by an external rotation force to the foot causing a Salter Harris type III injury [1-3]. It is typically seen in adolescents who have open epiphysis because the anterior tibiofibular ligament is stronger than the epiphyseal bone, and so the strong pull of this anterior tibiofibular ligament, predisposes to an epiphyseal bony injury rather than a ligament rupture leading to an avulsion physeal injury to anterolateral distal tibia [2,3]. Occurrence of this rare tillaux fracture in adults is further rare, because in adults i.e. after physeal fusion, ligament strength is less than bony strength and therefore a rupture of the ligament is more likely than a bony avulsion [4]. Only very few cases of this Tillaux fracture in adults has been reported [4-9]. In the present report, we describe such rare case of a Tillaux fracture in an adult, with aim to educate the clinicians about this rare injury in adults, which is worthy of discussion.

Case report

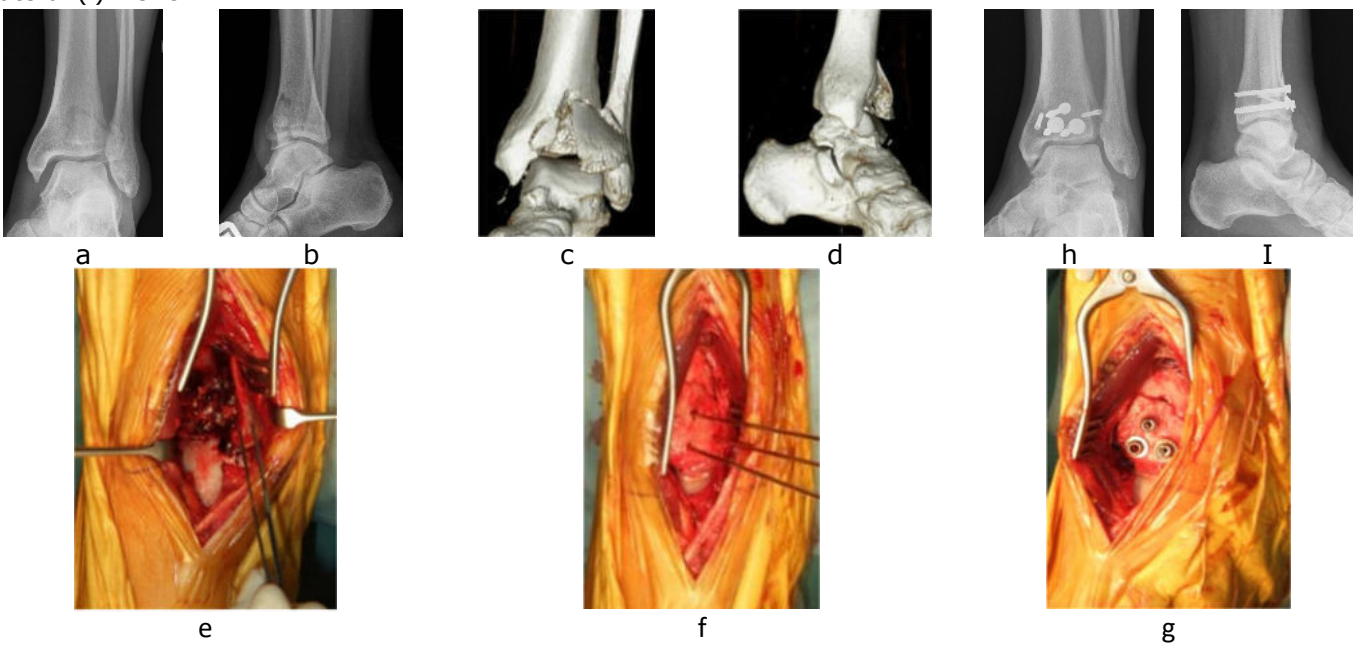
A 36-year-old gentleman presented to the emergency department immediately after trauma sustained in a football tackle. His body rotated internally when the foot was on ground, when he was hit by an opponent, giving external rotational force injury to the ankle. He complained of excruciating pain and severe swelling on the anterolateral aspect of distal tibia and ankle. He had superficial abrasions over the shin. No other injuries were identified. Distal neurovascular structures were normal. He had no significant previous medical history.

Plain radiographs of ankle showed a distal tibial avulsion fracture of the anterolateral aspect indicating a Tillaux-type injury. He was given analgesics and placed in a below knee plaster of paris back slab. He was admitted to the ward and limb was elevated. A CT scan of the ankle was performed to determine the extent of the fracture, to access the injury

three dimensionally and to plan the surgery. It confirmed an avulsion fracture of the distal anterolateral tibial cortex with an intact tibiofibular syndesmosis. This was deemed consistent with an adult-type Tillaux injury.

Since this was potentially unstable injury requiring anatomical reduction and internal fixation, we planned to treat the patient surgically. Patient was operated in supine position, under tourniquet under spinal anesthesia via anterior approach to ankle. Intra operative findings confirmed an avulsion fracture of the distal tibia with an intact tibiofibular ligament. The fragment was reduced and initially temporary fixed with k wires, after confirming reduction under C arm. Following this, 3 cannulated 4.5mm lag screws and 2 headless compression screws were passed to ensure stable hold and anatomical reduction of the articular surface (fig 1). Postoperatively, a back slab was applied and the patient's limb was elevated whilst swelling subsided. Check dressing was done on second postoperative day and oral antibiotics continued till five days. After suture removal at 2 weeks a complete below knee cast was applied. The post-operative regimen included non-weight bearing mobilization for a period of 6 weeks in a below knee cast. Partial weight bearing was instituted for a further 2 weeks and physiotherapy to mobilize the ankle was begun. Full weight bearing began at eight weeks along with proprioceptive rehabilitation. Radiographs at 6 weeks showed union of the fragment. Normal foot and ankle function was regained by three months.

Fig 1. Pre-operative AP (a) and lateral (b) x rays and 3-D reconstruction CT scan views (c and d) of the patient with tillaux type fracture fixed with CCS as shown in intra photograph (e to g) and post-operative AP (h) and lateral (i) views.



Discussion

Ankle syndesmosis is formed by distal tibia and fibula and is stabilised with four ligaments - the anterior and posterior tibiofibular ligaments, transverse tibiofibular ligament and interosseous membrane [1].

Sir Astley Cooper, was first to recognize the Tillaux fracture in 1822, as an avulsion injury to antero-lateral distal tibial epiphysis [10]. Tillaux fracture is an eponym given by Paul Jules Tillaux in 1892 who described this avulsion injury and its mechanism of injury following his experiments on cadavers. He described it as an external rotation of ankle that leads to an avulsion fracture of the anterolateral aspect of the tibial plafond owing to the pull of a taut antero-inferior tibiofibular ligament [11]. Chaput later described similar counterpart injury to the posterolateral tibia (avulsion of posterior tibio-fibular ligament), later called Tillaux-Chaput injury.

Distal tibial epiphysis appears at age 6-10 months and it unites with the diaphysis at about age 18 years [1]. Kleiger and Mankin showed that fusion in the distal tibial epiphysis occurs first in the middle third of the epiphysis, followed by, the medial side, and finally in the lateral portion [12]. Tillaux fracture occurs after the medial part of the physis has fused but before the lateral part closes, hence this injury is commoner in adolescents.

In adolescents, the lateral physis is open and anterior tibiofibular ligament is stronger than the epiphyseal bone (growth plate). When a strong external rotational force acts on ankle, it causes a pull force on this strong taut anterior tibiofibular ligament which rather than causing pure ligament rupture, predisposes to an avulsion epiphyseal bony injury leading to an avulsion physeal injury to anterolateral distal tibia. Further since the lateral physis growth plate is avulsed away with fracture line involving the joint, this Tillaux fracture is typically a Salter Harris type III physeal injury [2-4]. In adults this type of injury is very rare because physeal fusion has already been obtained and the ligament strength is less than the bony strength and ligament will usually give way and rupture before avulsion of its attachment to the anterolateral tibial plafond, leading to relative rarity of this avulsion fracture injury pattern in adults.

In adult type of tillaux fracture, the avulsed fracture fragment is triangular as compared to the juvenile one, where the fragment is quadrangular. Adult pattern of Tillaux fractures are classified into Type A and Type B. Type A is avulsion fracture of the antero-lateral aspect of the distal tibial plafond and Type B is a fracture pattern extending into the medial aspect resulting in antero medial pattern [6,7]. A few case reports are published, with this type of fracture in adults, but are not conclusive [4-9].

Like our case, Tillaux fracture is more common with sports related trauma that involves external rotation of the foot in relation to the leg. Children usually present with inability to bear weight along with painful and tender ankle especially in the anterior part of the ankle, after a low energy trauma, whereas in adults it is usually a high energy trauma and may be associates with other fractures [4-9].

Antero-posterior, lateral and oblique plain radiographs of the ankle are helpful in diagnosing this fracture. But un-displaced fracture or cursory examination of the radiographs can miss the injury, necessitating computed tomography as a useful adjunct to confirm the diagnosis, clearly define the extent of the fracture, rule out any associated injuries involving the tibial pilon and to plan management [13,14].

Acute management includes elevation, ice fomentation and rest. Un-displaced fractures can be managed non-operatively by below knee non-weight bearing cast immobilisation for six weeks. Since these are intra-articular fractures and usually displaced due to avulsion pull by the ligament, these injuries need closed or open reduction with internal fixation to restore ankle joint congruity aiming congruous reduction, rigid fixation, and early mobilization for better functional outcome and to prevent complications like nonunion, malunion, arthritis, deformity and avascular necrosis of the fracture fragment [6,7].

This open reduction can be done by anterior or the anterolateral approach [6]. As per Kumar et al anterolateral approach provides the best access to the fracture [9], but we used anterior approach for fixation and reduction, because we suppose the approach should depend on the extend of the fracture line. Since we have done CT scan, which showed the exact extend of the fracture line, we used the anterior approach for fixation. Careful use of wires as "joysticks" to achieve accurate reduction and fixation, with 1 or 2 inter-fragmental compression screws will usually be enough to stabilize the fractured fragment. Arthroscopy-assisted reduction and percutaneous fixation techniques have also been described to treat this injury, predominantly among adolescents [15].

Conclusion

Tillaux fractures are usually seen in the adolescent population but can, rarely occur in adults. Anatomical reduction and internal fixation leads to a full functional recovery and is recommended in the adult. Fixation is easier in the adult as one does not need to be concerned with iatrogenic physeal injury.

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Loss Of Swallowing Reflex Lasting For 42 Days After Anterior Cervical Decompression And Fixation Done For Traumatic Cervical Spine Injury: A Case Report

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Abstract

Case report: Post-operative dysphagia is a common complication seen after anterior approach to cervical spine, which is usually mild and recovers well over a period of four weeks. We present a rare case of severe dysphagia with inability to swallow, lasting 6 weeks after anterior cervical decompression and fixation, in a case of post traumatic cervical spine injury, which was treated conservatively. The causes, types and management strategies are discussed with aim to familiarize the surgeon with the complication.

Keywords: Anterior Cervical Spine, Dysphagia, Swallowing reflex

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Introduction

Smith Robinson approach to anterior cervical spine surgery, described more than 50 years ago is still the most commonly used approach for anterior cervical spine procedures [1-4]. It is easy to use, less time consuming, uses inter-muscular plane, gives wide exposure up to 3 disc spaces, and is associated with low blood loss and lower complication rates [4,5]. Most common complaint after this approach is dysphagia, reported in up to 69% cases, caused by medial retraction of esophagus along with trachea to expose the cervical vertebra [6]. It may be due to pharyngeal/esophageal wall ischemia, edema, hematoma, infection, injury to pharyngeal plexus, superior laryngeal nerve or recurrent laryngeal nerve, scar formation around cervical plates or bone graft dislodgement [7]. These patients feel pain while swallowing, which can be classified as mild, moderate and severe according to modified Bazaz Score [8]. Fortunately, this dysphagia is a transient phenomenon, which recovers well within 4 weeks and debilitating dysphagia is relatively uncommon [6,8]. We here present such a case of post-operative severe dysphagia without any structural damage lasting for 42 days, presenting with complete loss of swallowing function, not able to swallow his own saliva, who was fed with the help of Ryles tube and was under constant threat of aspiration, but recovered well with conservative treatment alone.

Case Report

A 55-year-old male patient sustained trauma due to road traffic accident and was referred to us, with complaints of severe neck pain and weakness in all 4 limbs. Radiographs of cervical spine showed C4-C5 facetal dislocation left side, which was confirmed on MR scan of cervical spine. Patient was planned for surgery after investigation and anesthesia fitness.

He was operated via anterior Smith-Robinson approach in supine position under general anesthesia. C4-5 disectomy was done followed

by reduction of facetal dislocation by vertebral body distraction. End plate preparation was done by curved curette and autologous tri-cortical bone graft was inserted between C4-5 vertebral bodies. Four-hole anterior cervical plate was applied between C4 and C5 above the bone-graft anteriorly (fig 1). Intra-operative period was uneventful and patient was shifted out of OT to the ICU.

Post-operatively, patient developed severe dysphagia and he was not able to swallow anything. He was spitting out his own saliva. ENT examination was done; all cranial nerves and laryngeal nerves were assessed and found to be normal. Direct and indirect laryngoscopy was also found to be normal. Chest X rays showed no mediastinal widening. Cervical spine X rays showed well reduced cervical spine with bone graft and plate in place (fig 1). Esophagoscopy was done to rule out any esophageal perforation/injury. Barium swallow study could not be done because patient was unable to swallow the liquid barium. All relevant mechanical causes of severe dysphagia were ruled out. MRI cervical spine & brain was ordered to assess for any other pathology which could hamper swallowing, but it came out to be normal except for mural thickening of laryngopharynx & upper most part of esophagus with resultant luminal attenuation (fig 2).

Fig 1: Pre-op antero-posterior (a) and lateral (b) and immediate post-operative lateral (c), 3 month (d) and 6 months (e) follow up lateral X rays of cervical spine with facetal dislocation, treated by anterior cervical plate and bone graft.

a b c d e

The patient was started on steroids and anti-inflammatory medicines along with a Ryles tube for his feeding. Patient was discharged with Ryles tube after stitch removal at two weeks, with improved neurology. Patient reported back to us after 6 weeks as he was able to swallow liquid food. Still the Ryles tube was kept in situ for 2 more days and asked him to swallow semi solid and mashed solid food with the tube. On 44th post-operative day we removed the tube. After that patient was having good swallowing function and had no problem till 6 months i.e. at last follow up (Fig 2).

Fig 2: Post-operative coronal section (a to d) of cervical spine MRI showing edematous mural thickening of laryngopharynx & upper most part of esophagus with resultant luminal attenuation.

a b c d

Discussion

Dysphagia is impairment in the speed and/or safe delivery of food or saliva from the mouth to esophagus increasing risk of aspiration. Bazaz graded dysphagia as none, mild, moderate or severe. Grade "none" indicates no swallowing difficulty with either liquids or solids, "mild" indicated no difficulty with liquids and only rare difficulty with solids "moderate" indicated no (or rare) difficulty with liquids and occasional difficulty with specific solids such as bread or steak and "severe" indicates rare (or occasional) difficulty with liquids and frequent difficulty with most solids [8]. Our case had severe functional dysphagia following anterior cervical spine fixation with complete loss of swallowing of both solid and liquid, which made him to sit all the time and spit out his saliva frequently to prevent aspiration.

Dysphagia can be caused due to abnormality in neural control of structures involved in swallowing process [9]. Swallowing reflex is divided into three phases - oral, pharyngeal, and esophageal. Oral phase starts with entry of the food into oral cavity and controlled by complex coordination of the soft palate, tongue, salivary glands, and facial muscles which are innervated by glossopharyngeal, hypoglossal and facial nerves. Pharyngeal phase involves involuntary coordination of laryngeal elevation, inversion of epiglottis and closure of vocal folds to prevent entry of food into airway, contractions from superior, middle, and inferior pharyngeal muscles to clear the food, with momentarily stoppage of respiration during this phase. Superior and recurrent laryngeal nerves play important role in this phase. The esophageal phase is completely involuntary and occurs through the coordinated peristalsis of the esophageal musculature controlled by myenteric plexus of Auerbach triggered by vagus nerve for this esophageal contraction [10].

The nerves involved in swallowing are at risk during anterior cervical spine surgeries, and hence postoperative dysphagia is a common complication associated with anterior cervical spine surgery [11-15]. Glossopharyngeal and hypoglossal nerves are vulnerable in surgeries involving C3 level or above. Superior laryngeal nerve is at risk in surgeries at C3-C4 level. Recurrent laryngeal nerve is at higher risk in surgeries at C6 level or below. The vagus nerve is vulnerable to retraction injury at any sub-axial cervical levels. Some surgeons consider postoperative dysphagia as an inevitable result of the surgery rather than a surgical complication [11,16].

Mild to moderate dysphagia is transient and recovers well within 4 weeks. But severe dysphagia after anterior cervical spine surgery requires urgent evaluation to exclude any potentially reversible surgical complications [17]. Patient history, physical examination, X-ray, direct or indirect laryngoscopy, and video radiographic swallow evaluation (VSE) are the primary modalities for evaluating oropharyngeal dysphagia [18]. History should include the onset, duration, severity and progression of the condition. Physical examination includes assessment of oral sensation, oral reflexes, and postural abnormalities, as well as motor assessment of face, lips, tongue, palate and larynx, level of arousal, ability to follow directions, and saliva management. Neurologic examination should include cranial nerve testing, especially the nerves involved in swallowing (the sensory components of cranial nerves V, IX, and X, and the motor components of cranial nerves V, VII, X, XI, and XII). Plain cervical radiographs rule out structurally induced dysphagia, caused by bone graft dislodgement, retropharyngeal abscess, postoperative edema or hematoma [13,17]. No identifiable neural or structural damage could be found in our case on clinical and neurological examination, cervical spine radiograph, direct or indirect laryngoscopy, and on MRI scan.

Goals of treatment in dysphagia are to maximize food transfer and prevent aspiration [19,20]. This includes various compensatory strategies for facilitating the safe and effective passage of bolus material like: (1) diet modifications: controlling bolus size or texture, avoiding certain foods; (2) heightening sensory input prior to or during swallowing; (3) modified swallowing maneuvers like applying voluntary control to swallow (breath

holding, effortful swallow); (4) protecting the airway with postural adjustments to reduce risk of aspiration (e.g., chin tuck, head tilt, head rotation, head lift, lying down); and (5) doing exercises to strengthen weak facial muscles, to improve range of oral or pharyngeal structural movement, and/or to improve coordination [17]. If the patient is still unable to swallow safely despite these rehabilitation strategies, then medical or surgical intervention may be necessary. Vocal cord medialization and devices such as palatal lifts can also be used to reduce aspiration risk. A temporary feeding tube may be needed in cases where aspiration risk cannot be reduced and/ or nutritional needs cannot be met [17].

We managed our patient conservatively with above modifications and temporary naso-gastric tube placement and he recovered fully after 6 weeks. Prognosis of dysphagia depends on complication which may develop from the condition, including pneumonia, dehydration, and malnutrition.

Conclusion

Postoperative dysphagia is a common complication associated with anterior cervical spine surgery, which is usually a mild and transient phenomenon, which recovers well. But if the condition is severe, it necessitates proper examination and investigation to rule out identifiable neural or structural cause.

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